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December 1994

US Army Corps of Engineers
Waterways Experiment Station

Analysis of Inorganic and Organic Contaminants in Freshwater Mussels from the Big Sunflower River, Mississippi: October 1993

by Henry E. Tatem, Charles R. Lee, WES
Stuart Patterson, AScI, Inc.
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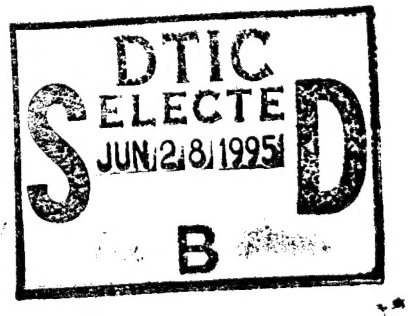

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Final report

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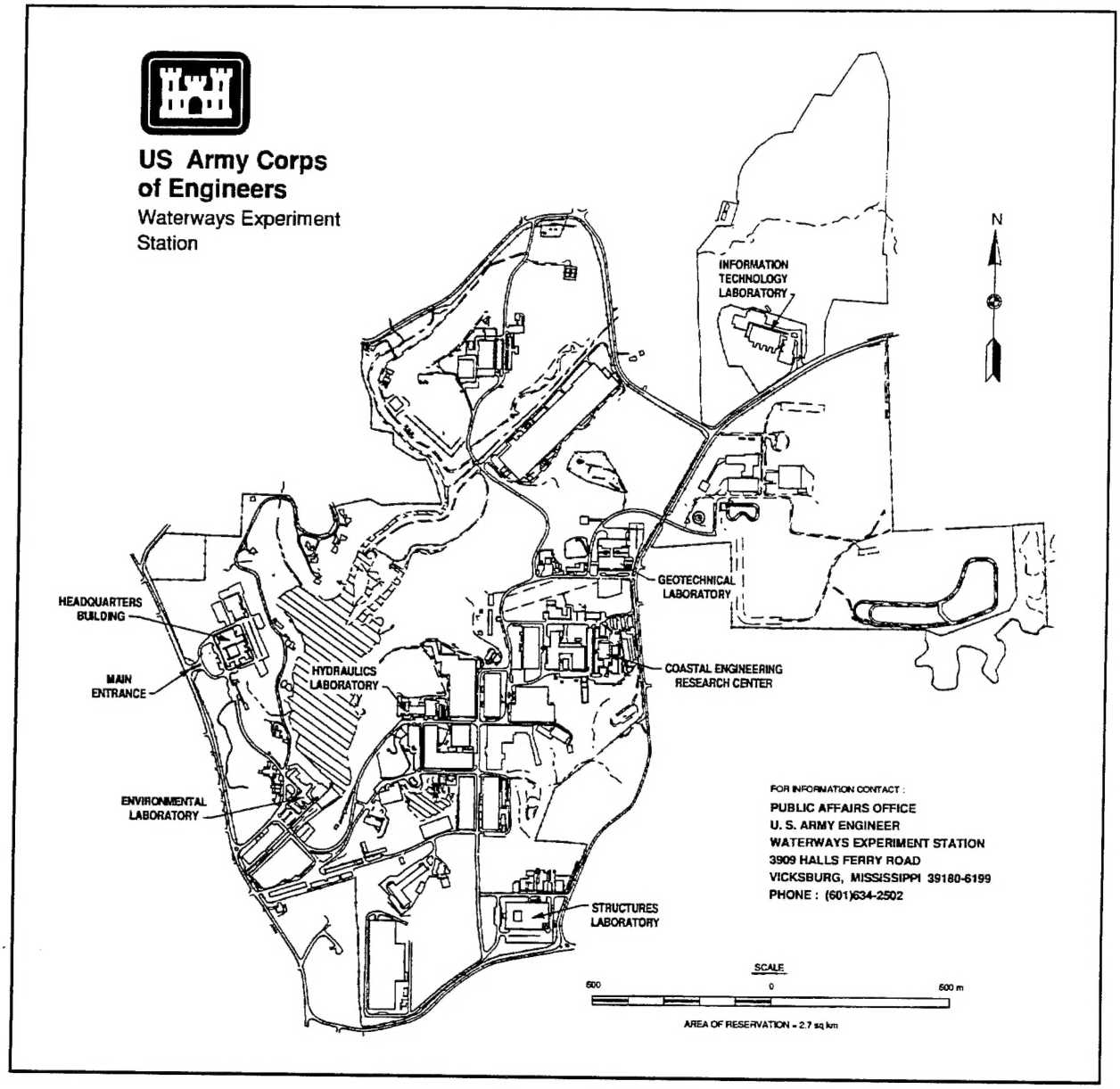

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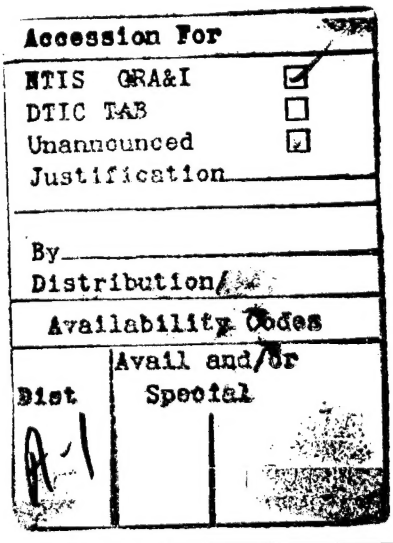

Preface

The report herein contains chemical data on freshwater mussels taken from the Big Sunflower River, Mississippi. The work was conducted by the Environmental Laboratory (EL), U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS, for the U.S. Army Engineer District, Vicksburg. The Principal Investigator for this report was Dr. Henry E. Tatem, Fate and Effects Branch (FEB), Environmetal Processes and Effects Division (EPED), EL.

The report was prepared by Dr. Tatem, Dr. Stuart Patterson, AScI, Inc., Vicksburg, MS, Ms. Lisa Lefkovitz, Battelle Marine Sciences Laboratory, Sequim, WA, and Dr. Charles R. Lee, FEB. The authors acknowledge Drs. Andrew Miller and Barry Payne, Aquatic Ecology Branch, Ecological Research Division, EL, for collection and identification of the mussel species and Mr. Marvin Cannon of the Vicksburg District for support. Dr. Patterson and Ms. Joan U. Clarke, FEB, conducted statistical analyses of the data. Technical reviewers were Ms. Clarke and Dr. Michael Honeycutt, FEB.

The work was performed as a Contaminant Mobility and Assessment Team project, Dr. Lee, Team Leader. This project was conducted under the supervision of Dr. Bobby L. Folsom, Jr., Chief, FEB, Mr. Donald L. Robey, Chief, EPED, and Dr. John W. Keeley, Director, EL.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

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1 Introduction

Marine and freshwater mussel species have been widely used to assess the contaminant status of aquatic ecosystems. They are good indicator species for aquatic contaminants because of their sedentary nature and lifestyle. Many freshwater mussels, also called clams or unionids, live for many years continuously filtering water for food particles and oxygen. They are normally closely associated with sediments that are known to adsorb contaminants such as pesticides and metals. The mussel species most widely used for contaminant monitoring is probably the marine blue mussel *Mytilus edulis* (Nelson 1990). Freshwater mussels, however, such as *Anodonta* and *Lampsilis*, are also used to assess aquatic ecosystem health (Burton, Nelson, and Ingersoll 1992). A recent review of the conservation status of North American freshwater mussels (Williams et al. 1993) describes freshwater mussels as good indicators of the overall health of aquatic ecosystems.

Fisher et al. (1992) provide an overview of mussels and contaminants and compare contaminant bioaccumulation by marine mussels with the freshwater zebra mussel *Dreissena polymorpha*, a recently established North American mussel species. It is not unusual for mussels to accumulate aquatic contaminants to concentrations much higher than the waters where they are found. For example, Doherty, Evans, and Neuhauser (1993) discuss research performed in the 1980s showing that the Asiatic clam *Corbicula* can contain metal and organic contaminants at concentrations greater than 1,000 times ambient water concentrations. This kind of dramatic bioconcentration data is not normally true for sediment comparisons. Mussel tissue concentrations of contaminants are generally similar to or only slightly higher than most sediment contaminant concentrations. Specific organic contaminants, however, such as pesticides, may be found in aquatic animal tissues at concentrations greater than sediment levels if the sediment concentrations are low.

It is reasonable to conclude from these studies that mussel species living in the Big Sunflower River, which flows through the Mississippi delta, could contain harmful environmental contaminants. The Mississippi delta is an intensive agricultural region east of the Mississippi River and north of Vicksburg, MS. The primary concern is with pesticides from agricultural crops. However, other contaminants such as polychlorinated

biphenyls (PCBs) and metals are generally widespread and are normally included in studies of the contaminant status of an ecosystem.

In connection with a planned maintenance dredging project on the Big Sunflower River, private companies have expressed an interest in harvesting certain mussel species for their shells (Huffman 1994). Current plans are to remove the mussel soft tissues from the shells and use the tissues as feed for farm animals. Questions may arise concerning the use of mussel tissues for animal feed. Obviously the tissues should not be used for animal feed if it is determined that they contain elevated concentrations of contaminants. There are little or no data available on the contaminant status of these Big Sunflower mussels. The purpose of this report is to determine the concentrations of three classes of contaminants (pesticides, PCBs, and metals) in the mussels and to determine the suitability of the soft tissues as animal feed.

2 Materials and Methods

Divers or people wading in shallow areas collected various mussel species from the Big Sunflower River, Mississippi, during September and October 1993. Animals were obtained from at least eight sites from River Miles 34.5 to 150 for the contaminant analyses. Live animals were transported to the U.S. Army Engineer Waterways Experiment Station (WES) Environmental Laboratory, Vicksburg, MS, as they were collected. At the laboratory, the animals were rinsed thoroughly with tap water and temporarily placed in aquaria containing aged tap water. Mussels were held in separate aquaria according to species and site. After 18 to 20 hr, they were killed by freezing and labeled by species and site. The animals were frozen and stored in a standard freezer (-5 °C) until all collections had been accomplished and efforts were made to obtain similar species from as many sites as possible. The statement of work called for tissue analyses of mussels from three to five sites along the Big Sunflower River, three species per site and possibly two size classes for each species. Mussel species were identified by the WES collection team. Additional information on these animals is available in a separate report (Miller and Payne, in preparation).

Animals were removed from the freezer, by species and site, and thawed; soft tissues were separated from the shells. Originally, each animal was maintained as one sample. After the shucking process was completed, the fresh weights of each sample were determined. The decision was made to use two animals as one sample for the larger species and to use three or four animals as a sample for the smaller species. The fresh wet tissues were homogenized and placed in precleaned sample jars (Eagle Picher, Miami, OK) and shipped to the chemical laboratory (Battelle Marine Sciences Laboratory at Sequim, WA) for analyses during November 1993. Not all species from each site were analyzed because of costs associated with this kind of work. In some cases, only a few animals of a particular species were obtained at a given site. Since more than five sites were sampled and at least two of the sites were located within less than 1 river mile, the decision was made to analyze animals from only one of these two sites. All metals except for mercury were analyzed by Inductively Coupled Plasma/Mass Spectrometry methods following digestion of aliquots with a mixture of nitric and perchloric acids. Mercury (Hg) was analyzed by Cold-Vapor Atomic Absorption Spectroscopy

methods. Pesticides and PCBs were analyzed using Gas Chromatography/ Electron Capture Detection methods following extraction with methylene chloride. Additional information and details on chemical analysis methods and references can be found in the appendixes of this report.

3 Results and Discussion

Table 1 contains information on sites sampled and species obtained for the contaminant analyses. Eight sites were sampled with a total of 29 to 30 different site-species combinations represented. Some species were found only at one site. Examples of these are *Anodonta grandis* and *Lampsilis teres* at River Mile (RM) 63.3 and *Quadrula nodulata* at RM 76.0. Species used for the chemical analyses are noted in Table 1. Three species were found at all or nearly all of the sites. These were *Quadrula pustulosa*, *Amblema plicata*, and *Plectomerus dombeyanus*. These species were selected for chemical analyses at as many sites as possible. RM 63.3 was found to contain the most species of the sites sampled for chemical analyses. Site 35.1 animals were not analyzed because of the close location of Site 34.5. Mussels from Site 34.5 were analyzed.

Chemical analysis data for six metals and six pesticides are presented in Tables 2-7. Data are organized by RM and mussel species. Complete data sets for all contaminants determined are available in Appendixes A and B of this report. The appendixes also include quality assurance/quality control (QA/QC) data for these analyses.

Figures 1-7 show mean (±SE) concentrations of selected contaminants found in one of the mussel species, *Amblema plicata*, tissues at seven of the eight Big Sunflower River sampling sites. Data on the number of mussels taken at each site are presented in Table 1. Color photographs of some of the Big Sunflower mussels collected for this study are shown in Figures 8-15. Two classes of contaminants, metals and pesticides, were found in the tissues. The metal concentrations are reported as parts per million (ppm) dry weight, while the pesticides are reported as parts per billion (ppb) wet weight. The mussels (all species) did not contain detectable concentrations of PCBs. PCBs were analyzed as Aroclors (1242, 1248, 1254, and 1260) and were not detectable at 5 ppb (Appendixes A and B). The data shown in Figures 1-7 indicate that these mussels (species *A. plicata*) contained both metal and pesticide contaminants at all of the sample locations. Contaminants shown in the seven figures include Cd (Figure 1), Hg (Figure 2), Pb (Figure 3), DDE (Figure 4), DDD (Figure 5), toxaphene (Figure 6), and DDT (Figure 7). The pesticide levels shown appear to be generally high. It is somewhat unusual to find this many pesticides at detectable concentrations in aquatic tissues. Similar

results were obtained for the other mussel species analyzed. These data and additional data for other mussel species are presented in Tables 2-7 and in the appendixes of this report.

The chemical data show that these adult freshwater mussels from the Big Sunflower River contain, in their soft tissues, detectable concentrations of nine metals, approximately 14 pesticides, and no PCBs (see Tables 2-7 and appendixes). There are no obvious sampling sites or species that were found to be completely uncontaminated or to contain only a few contaminants at low concentrations. Cadmium (Cd), for example, was found at concentrations ranging from 0.218 ppm at RM 62.2 (species *P. dombeyanus*) to 1.85 ppm for species *Q. pustulosa* at RM 34.5 (Table 2). Replicate sample tissue concentrations were in the same range for both species at both sites, and every species at every site contained detectable concentrations of Cd. All metals except for Cr were detected at every site. Chromium (Cr) concentrations were less than detection limits for all three species (*A. plicata, P. dombeyanus*, and *Q. pustulosa*) at RM 140/150. It is not unusual to find detectable levels of some metals in aquatic tissue samples.

Freshwater and marine mussels and other bivalves usually contain some metals. For example, Doherty, Evans, and Neuhauser (1993) analyzed zebra mussels, *Dreissena polymorpha*, from two power plants located in New York and Canada and found the following metals in the tissues:

ppm (wet weight)								
	Cd	Cr	Cu	Hg	As	Pb	Se	Zn
Range	<1.0	<2.0	9.0	<0.02	<0.5	<20	<0.2	2.1
	0.6	14.0	16.0	<0.1	0.53	100	0.25	6.2

These values would be approximately three to four times higher on a dry weight basis.

Mills et al.(1993) analyzed two mussel species from Lake Ontario and reported metals data on a dry weight basis. They stated that the levels of Cd, Ni, Pb, and Se were excessive and deserved further study. Their data are summarized below:

ppm (dry weight)								
	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Range	3.03	2.41	2.57	0.08	3.58	1.80	3.10	70.8
	11.90	5.33	25.80	0.28	12.60	7.90	4.50	309

The literature data indicate that, in general, the Sunflower mussels do not contain substantially elevated concentrations of metals. Another way of interpretating these data is to compare the concentrations found in the mussel tissues with either the U.S. Food and Drug Administration (USFDA) action limits or the U.S. Fish and Wildlife Service (USFWS) predator protection limits (U.S. Environmental Protection Agency/U.S. Army Corps of Engineers (USEPA/USACE) 1994; Inmon, Smith, and Facemire 1993). These references contain tables for the action limits and predator protection limits (PPL) for some contaminants. The PPL for some of the metals are (ppm wet wt) Cd - 0.5, Cr - 0.2, Pb - 0.3, Hg - 0.1, Se - 0.5. The metal concentrations shown in Tables 2-4 are reported on a dry weight basis, which means that they would be lower on a wet weight basis. The mussels averaged over 80-percent moisture in their tissues. Most of the samples analyzed for this report do not exceed the PPL concentrations. The data, however, for Se and Cr (Tables 3 and 4) are within the PPL range and are a reason for caution.

The organic contaminant analyses, including the pesticides and PCBs, show many pesticides present. The pesticides found include aldrin, D-BHC, heptachlor epoxide; g-chlordane, a-chlordane, trans-nonachlor; 4,4'-DDE, dieldrin, 2,4'-DDD, 4,4'-DDD; endosulfan II, 4,4'-DDT, endosulfan sulfate; and toxaphene. Pesticide concentrations are reported in the tables and in the appendixes on a µg/kg (ppb) wet weight basis. The PPL values for dieldrin and DDTM (DDT + metabolites) are 0.1 and 1.0 ppm, respectively. These values are generally much higher than those found in the Sunflower mussels. Other pesticides found in these mussels do not have PPL values. The USFDA action levels (USFDA 1987 and Lee et al. 1991) for some of the pesticides found in the Sunflower River mussels are given below for human food and animal feed (ppm wet weight):

	Human Food	Animal Feed
BHC	0.3	0.05
chlordane	0.3	0.10
DDT + DDE	5.0	0.50
toxaphene	5.0	0.50
dieldrin + aldrin	0.3	--
heptachlor epoxide	0.3	0.01

Most of the DDTM values are less than one-fourth of the PPL criteria, but the mussels were shown to contain the pesticide toxaphene at concentrations equal to or greater than those for the DDTM and dieldrin. According to the USEPA water quality criteria chart, toxaphene is similar to dieldrin. Both pesticides are listed as carcinogens, and the freshwater chronic criteria are similar. The USFDA publication listing contaminant action levels (USFDA 1987) shows that acceptable concentrations for animal feed are all below the 1.0-ppm concentration. Some of the Big

Sunflower mussels had toxaphene concentrations that approached the USFDA action level of 0.5 ppm. This information, combined with the number of pesticides found, is an indication that these mussels should not be used as food for farm animals and that normal precautions should be used in handling and disposal of the tissues. The tissues should be disposed of at an approved landfill. The pesticide data suggest that additional study of toxaphene concentrations and sources in the Big Sunflower River ecosystem is warranted.

A statistical analysis of the contaminant data was performed. Data for all species were combined at each RM and compared with the PPL values (Table 8). Contaminants with PPL values were Cd, Cr, Pb, Hg, Se, dieldrin, and DDTM. The metals data were converted to wet weight for these analyses, using an average moisture content of 84 percent. Upper 95-percent confidence limits of the mean contaminant concentrations were calculated and compared with the PPL criteria. These statistical procedures are discussed in USEPA/USACE (1994) (Appendix D). The data showed that the 95-percent upper confidence limits (UCL) were not much higher than the actual data and that UCL for only two metals, Se and Cr, exceeded the PPL values. A summary of the statistical comparisons is shown in Table 8. Additional information is available in Appendix C of this report.

Data in Table 8 also may be used for general comparison of the relative contamination of RM sites along the Big Sunflower River. For some of the contaminants, there was little difference in the 95-percent UCL at each RM. Examples of this are data for Hg and Se. For other contaminants, these data are an indication that the mussels at one or more RMs are more contaminated compared with the other RMs. The best example of this is dieldrin, where the values at RM 76.0 and RM 79.2 were much lower than the values at the other five RM sites.

4 Summary

Chemical analyses of freshwater mussels taken from the Big Sunflower River, Mississippi, in 1993 showed that the mussels contained detectable concentrations of metals and pesticides. PCBs were not found at detectable concentrations. The metals found included Cd, Hg, Pb, Ni, Se, and Cr. Most aquatic animals contain detectable levels of metals in their tissues; however, the tissue concentrations found in these mussels were in a range that could be expected for animals taken from moderately contaminated sites. Tissue concentrations for two metals, Se and Cr, were greater (95-percent UCL) than the PPL at one (Se) or most (Cr) of the RM sites. The tissue concentrations are likely related to the age (>20 years) and lifestyles of these mussels. The pesticides identified in these mussels included chlordane, dieldrin, DDE, DDD, DDT, toxaphene, and others. These contaminants are not normally found in aquatic animals and indicate pesticides are present in this ecosystem. Tissue concentrations of pesticides are likely related to the age of the mussels and are probably not extremely high considering the heavy agricultural use of the Big Sunflower River watershed. Some concentration of contaminants was found for all species at all sites. Tissue concentrations (95-percent UCL) for dieldrin and DDTM did not exceed the PPL values. However, there is no PPL value for toxaphene. Toxaphene was found at all RMs and in all species at higher concentrations than any other pesticide. If toxaphene is judged by the dieldrin PPL, it is likely that the 95-percent UCL would exceed the PPL value of 100 ppb (0.1 ppm) for some of the RMs. Toxaphene was generally below the 100-ppb level at RMs 76.0 and 79.2. The USFDA action level for toxaphene in animal feed is 0.5 ppm or 500 ppb. Mussels analyzed from between RMs 60 and 70 revealed toxaphene concentrations of approximately one-half of this concentration.

These data, then, do not reveal an obvious overall trend that would suggest that the metal and pesticide contamination was specific to any particular species or site. Based on these data, it is recommended that mussel tissues not be used as food for farm animals, but be treated as an organic waste and disposed of at an approved landfill. It is possible that the usual feed for farm animals contains some concentration of metals and pesticides. This should be considered if there is some reason why landfill disposal would be a problem or if a local farmer wanted to use these mussels for feed knowing that they contained concentrations of metals and

pesticides. Normal precautions should be employed during handling and processing of these animals. They should not be used as food for people or disposed of in an aquatic habitat.

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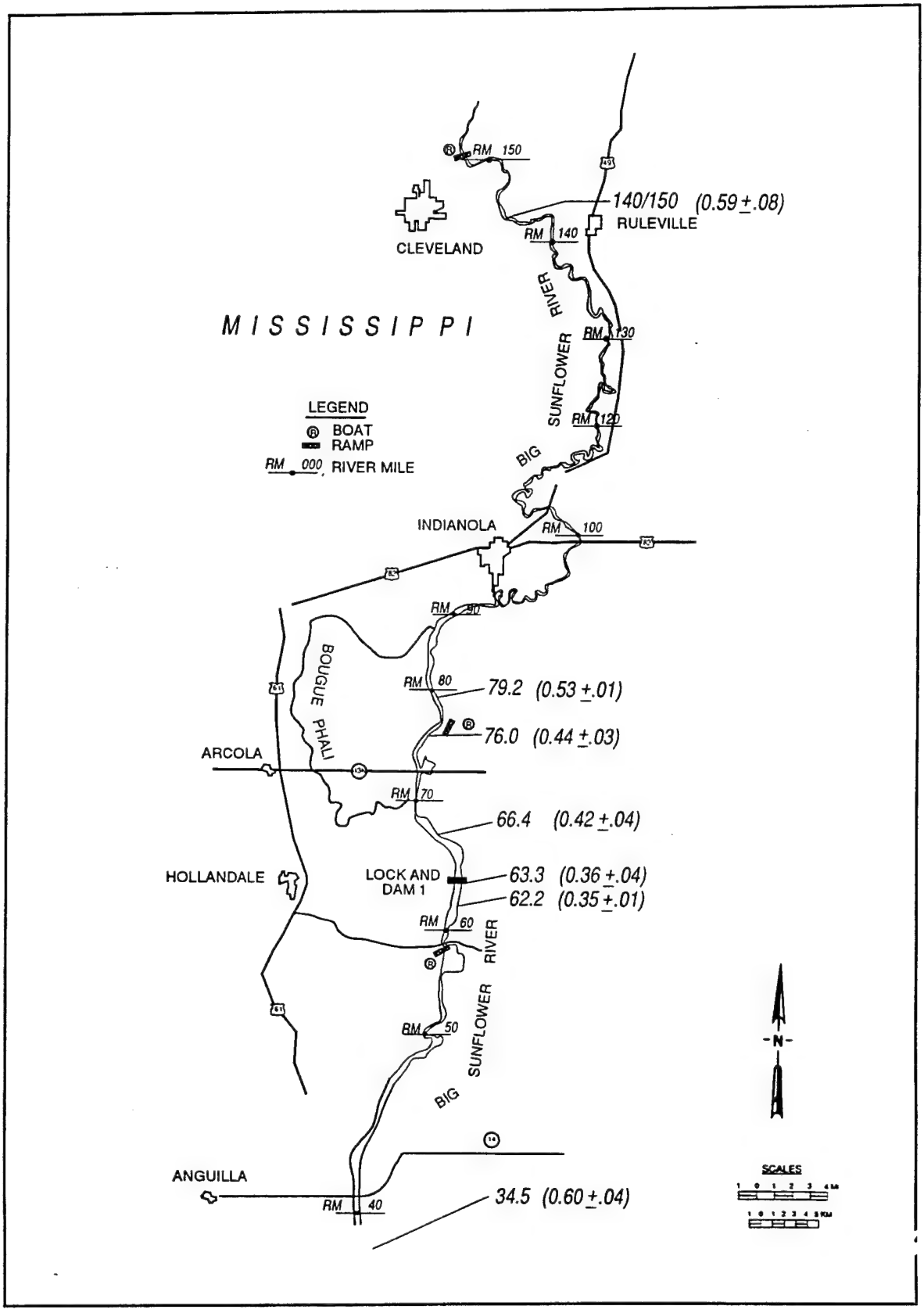

Figure 1. Mean ± SE concentrations of Cd (ppm) in Big Sunflower River mussel *Amblema plicata*

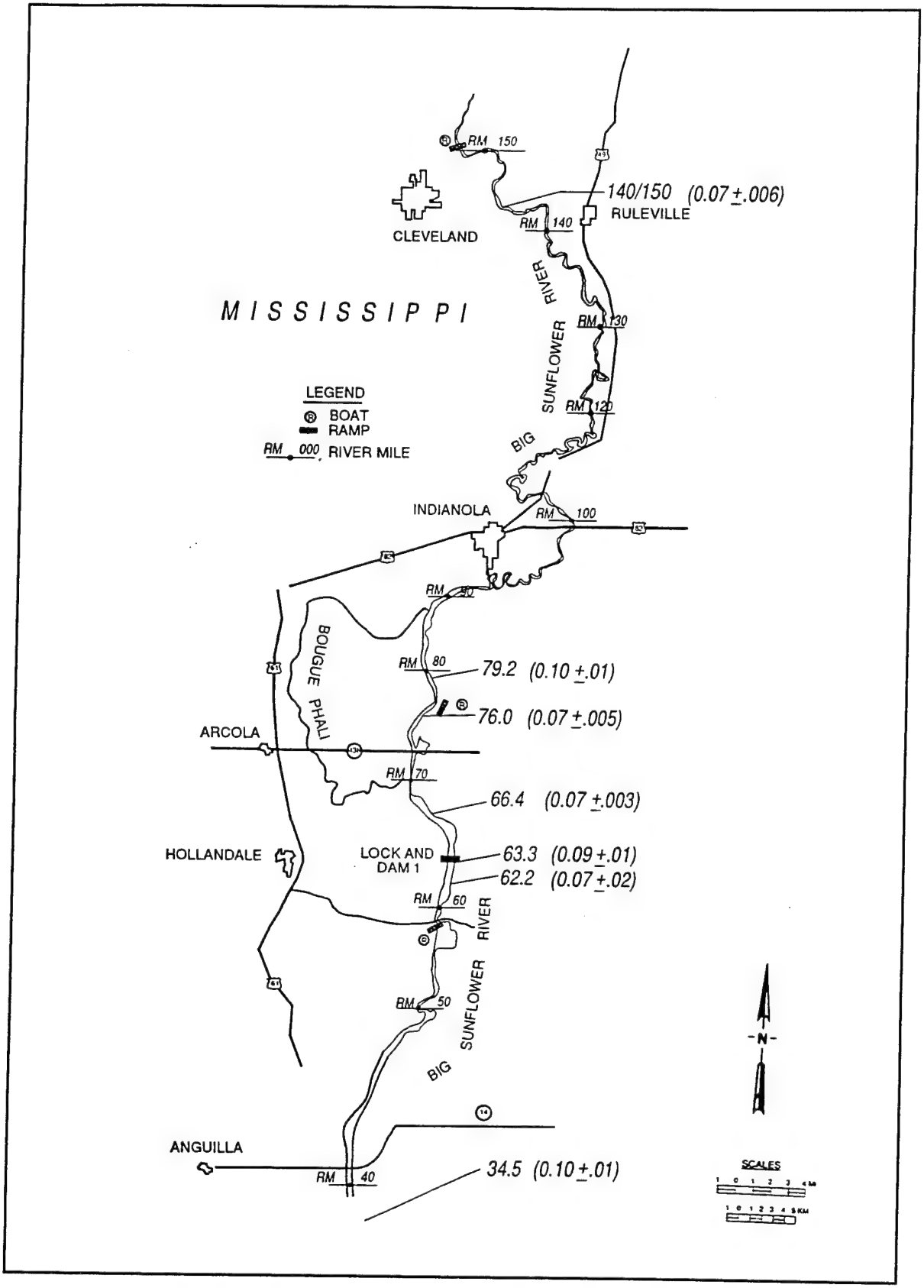

Figure 2. Mean ± SE concentrations of Hg (ppm) in Big Sunflower River mussel *Amblema plicata*

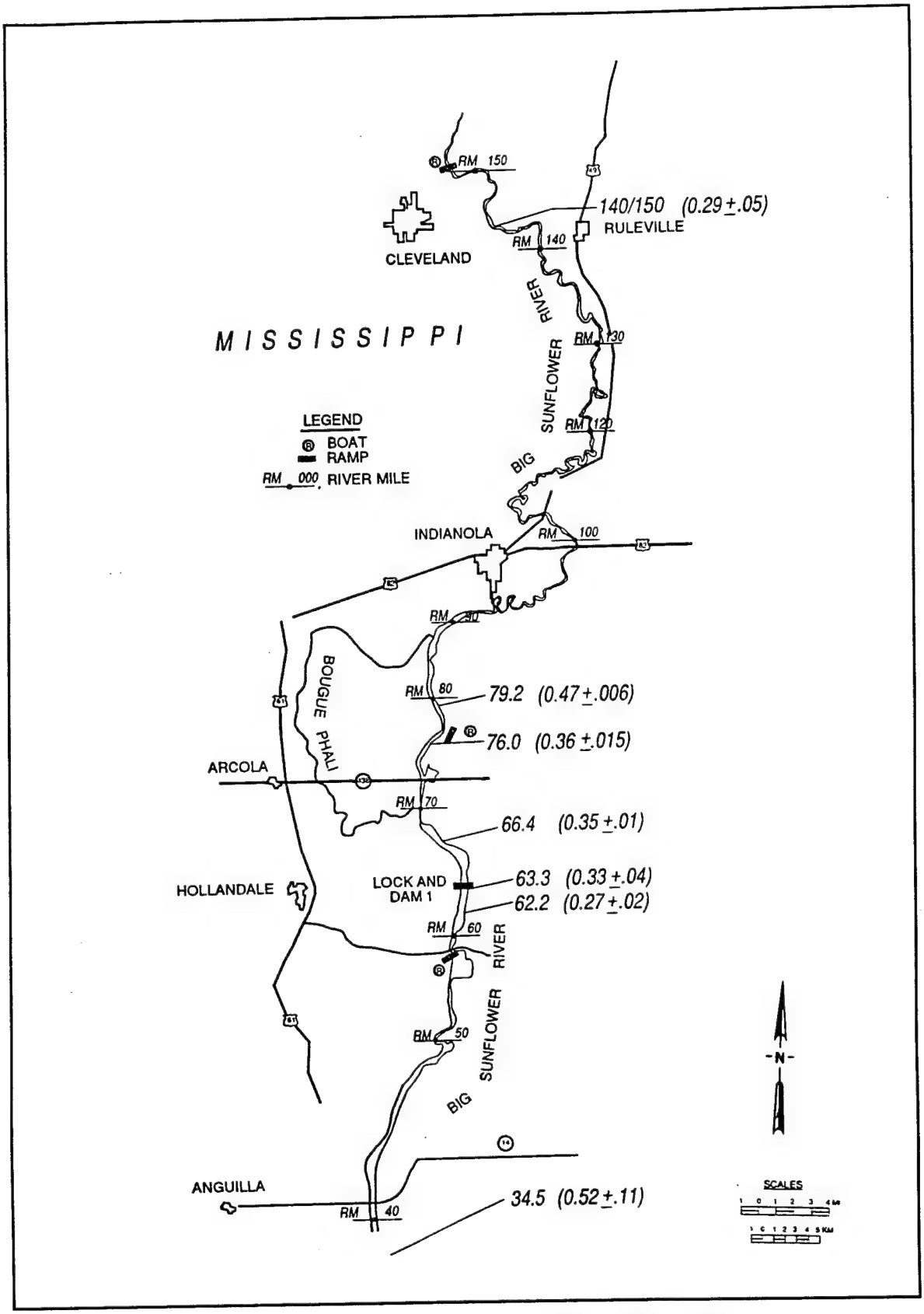

Figure 3. Mean ± SE concentrations of Pb (ppm) in Big Sunflower River mussel *Amblema plicata*

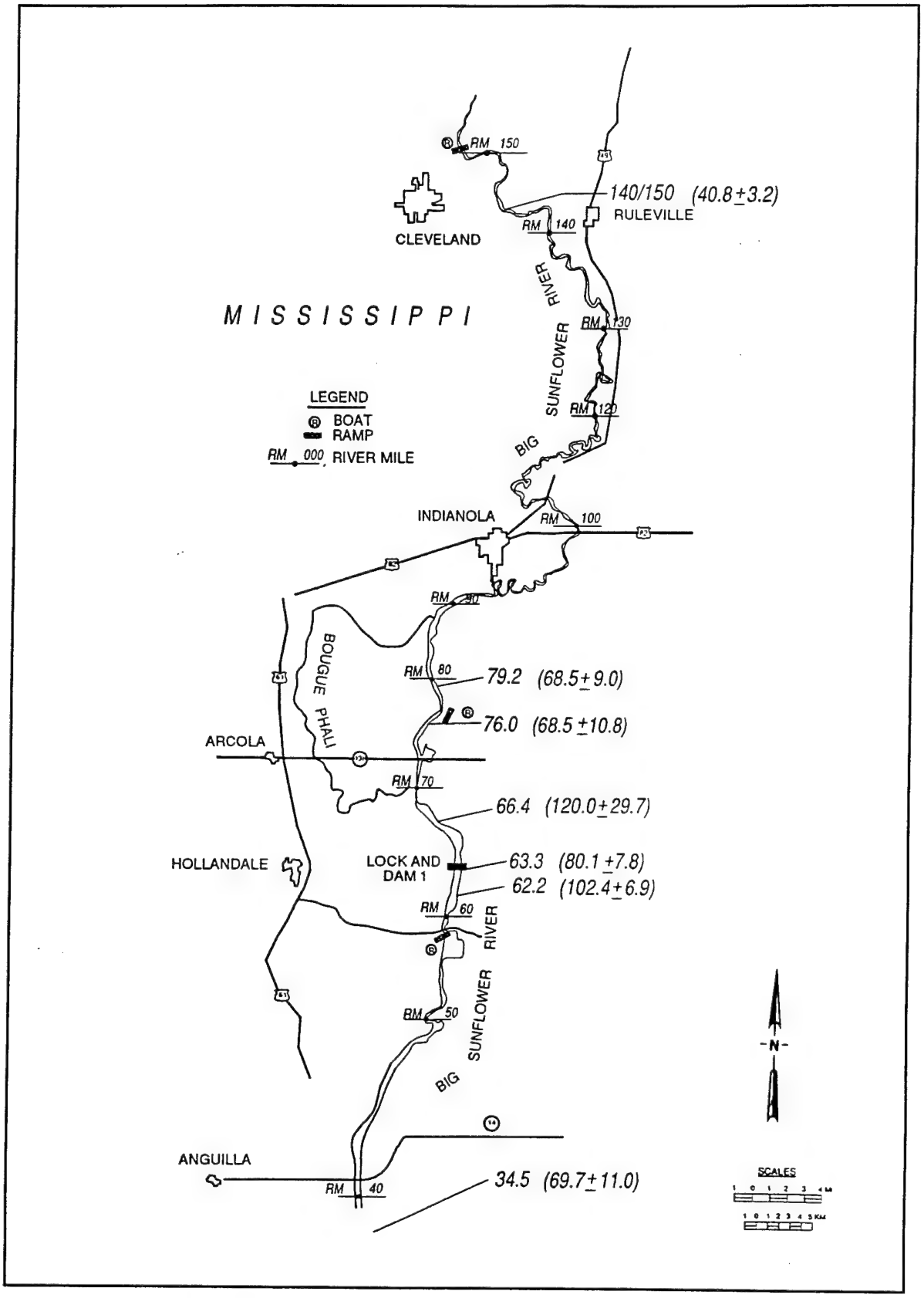

Figure 4. Mean ± SE concentrations of DDE (ppb) in Big Sunflower River mussel *Amblema plicata*

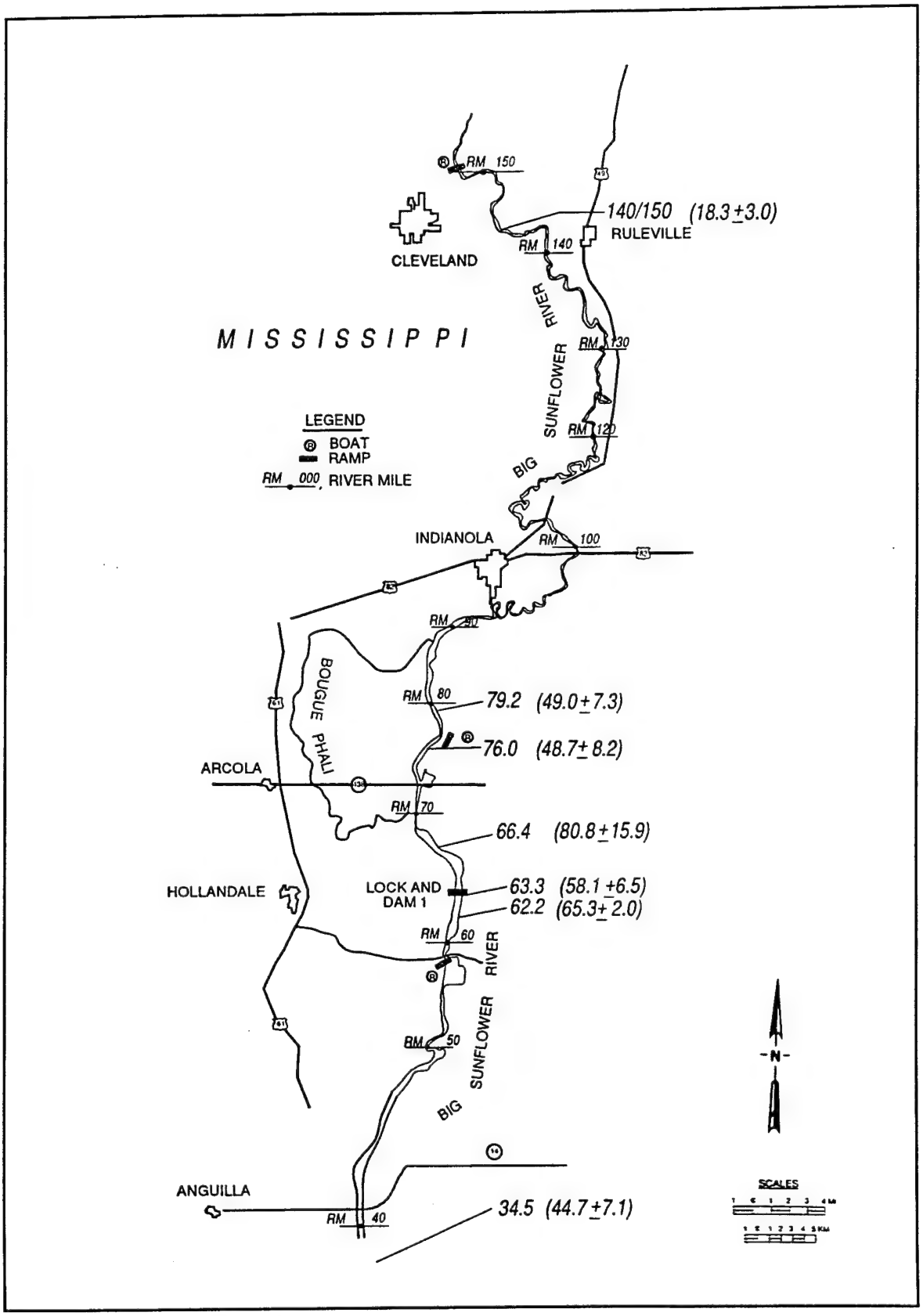

Figure 5. Mean ± SE concentrations of DDD (ppb) in Big Sunflower River mussel *Amblema plicata*

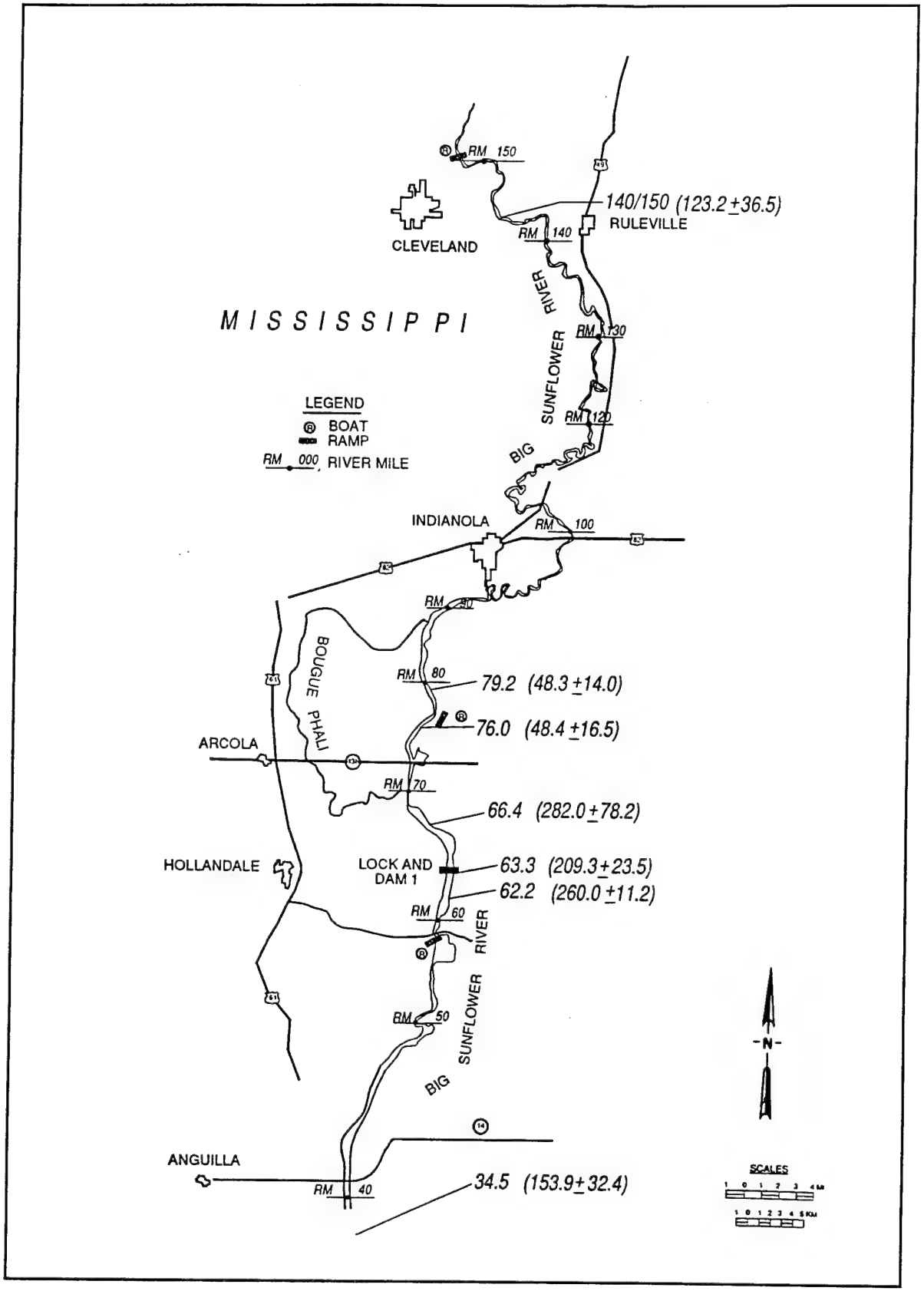

Figure 6. Mean ± SE concentrations of toxaphene (ppb) in Big Sunflower River mussel *Amblema plicata*

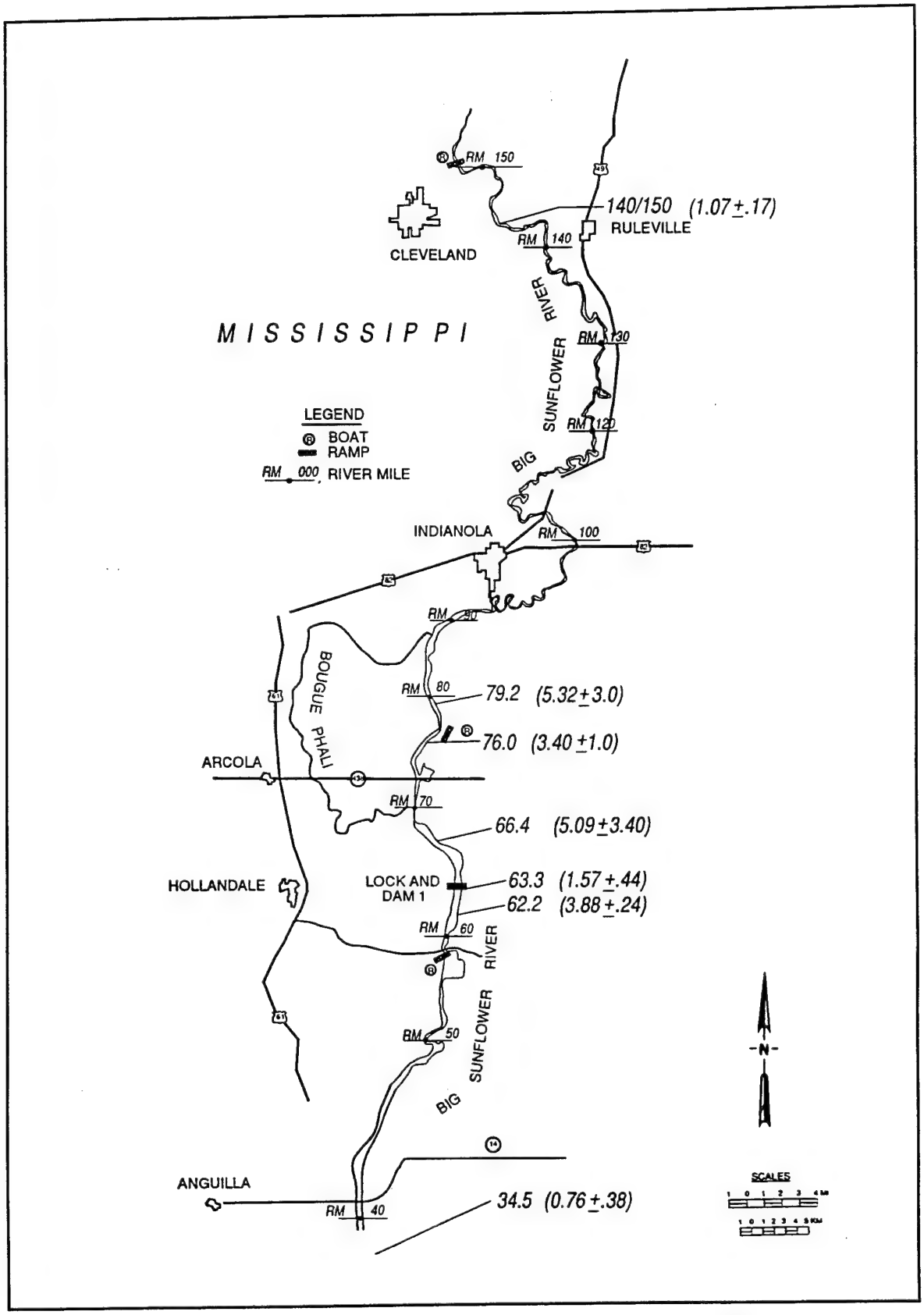

Figure 7. Mean ± SE concentrations of DDT (ppb) in Big Sunflower River mussel *Amblema plicata*

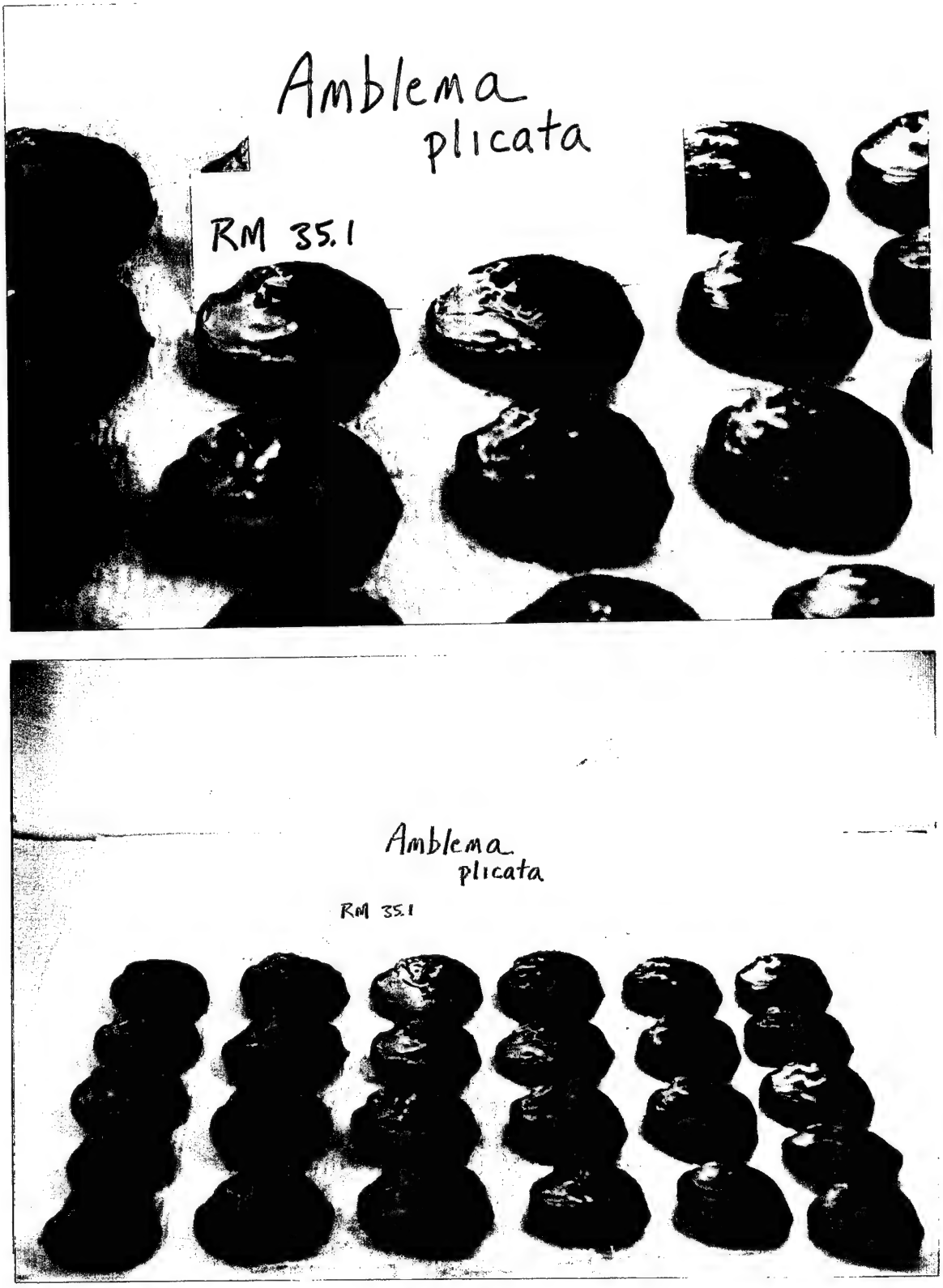

Figure 8. *Amblema plicata* from RM 35.1 on Big Sunflower River, Mississippi

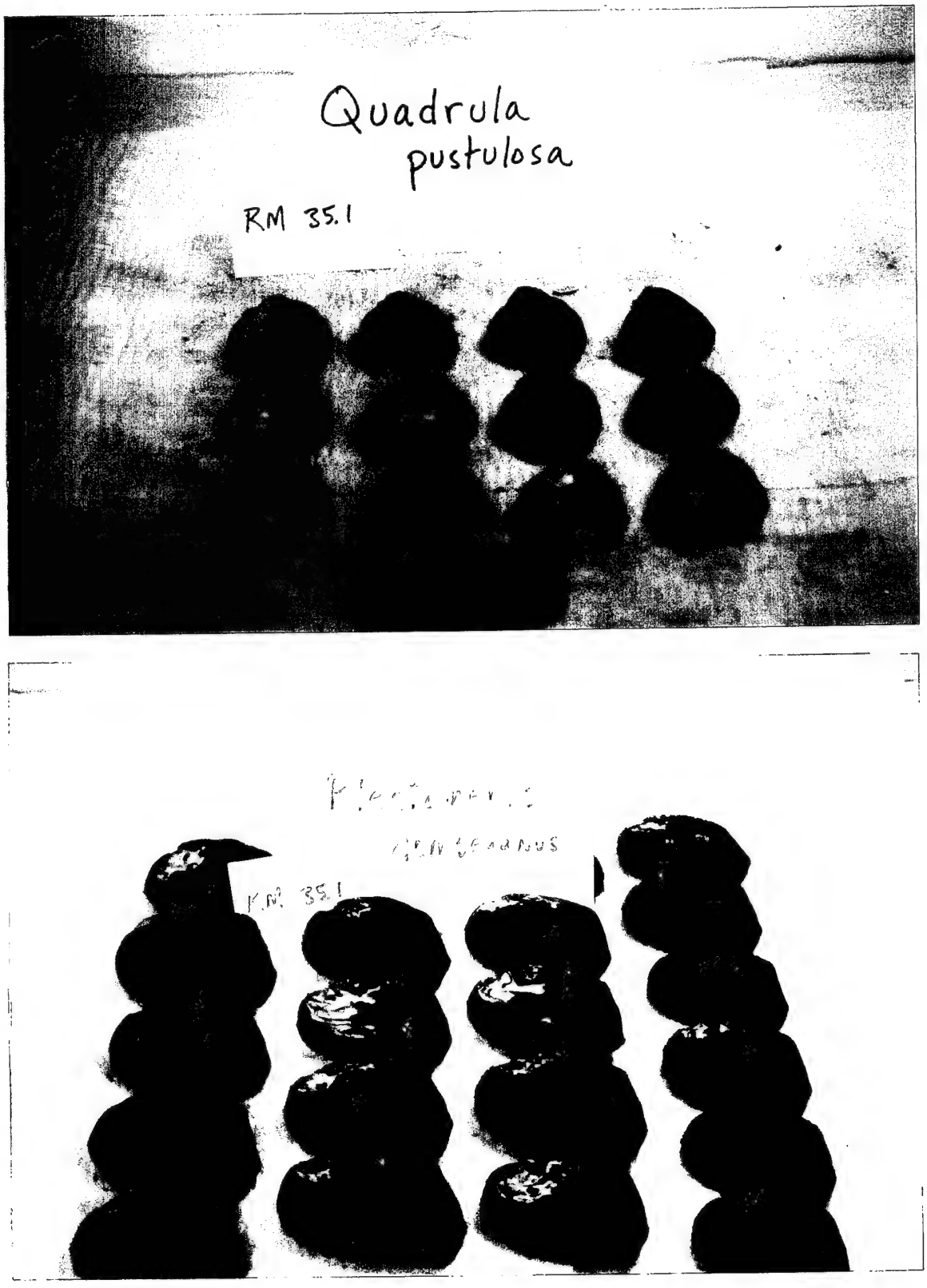

Figure 9. *Quadrula pustulosa* and *Plectomerus dombeyanus* from RM 35.1 on Big Sunflower River, Mississippi

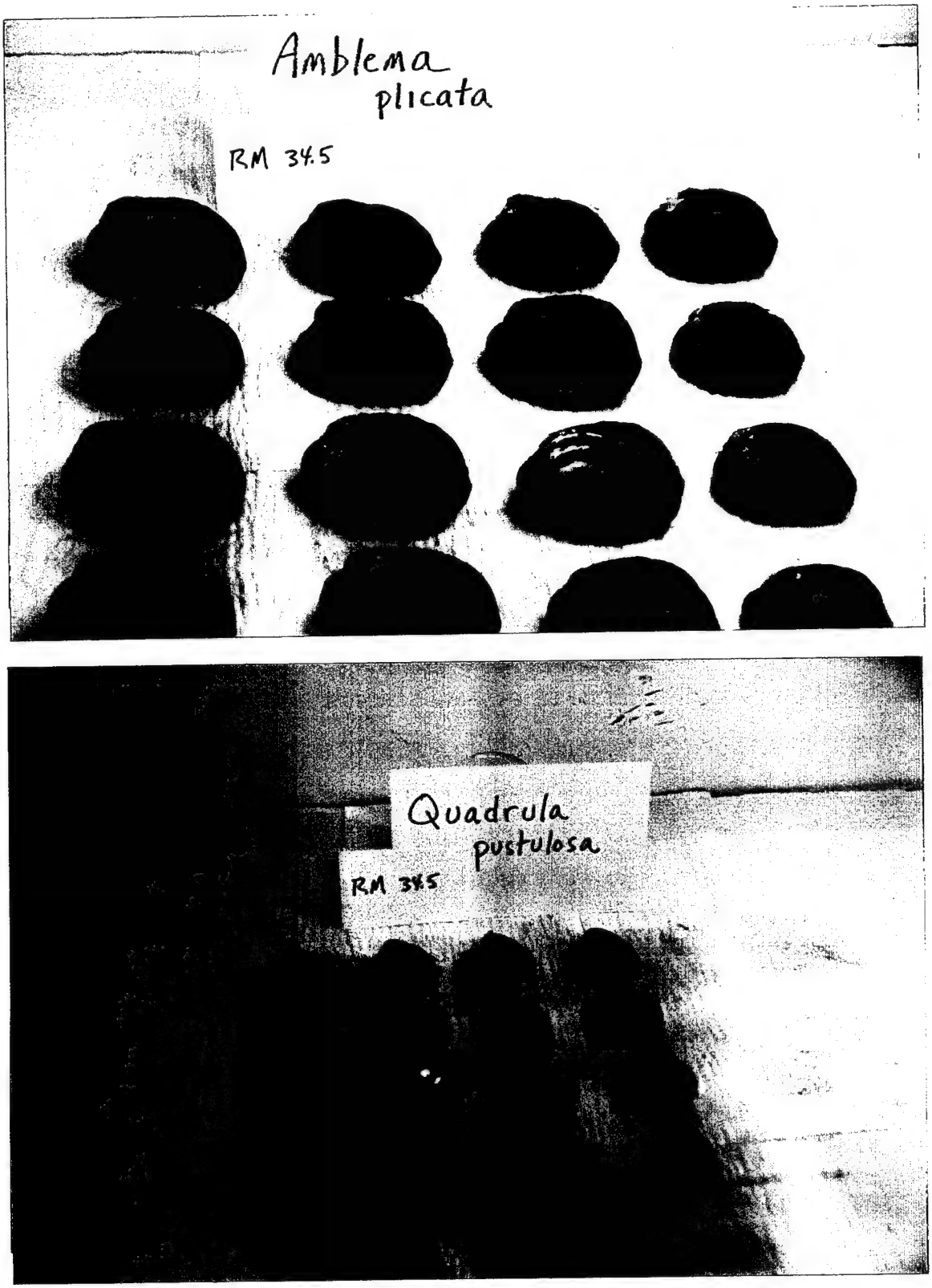

Figure 10. *Amblema plicata* and *Quadrula pustulosa* from RM 34.5 on Big Sunflower River, Mississippi

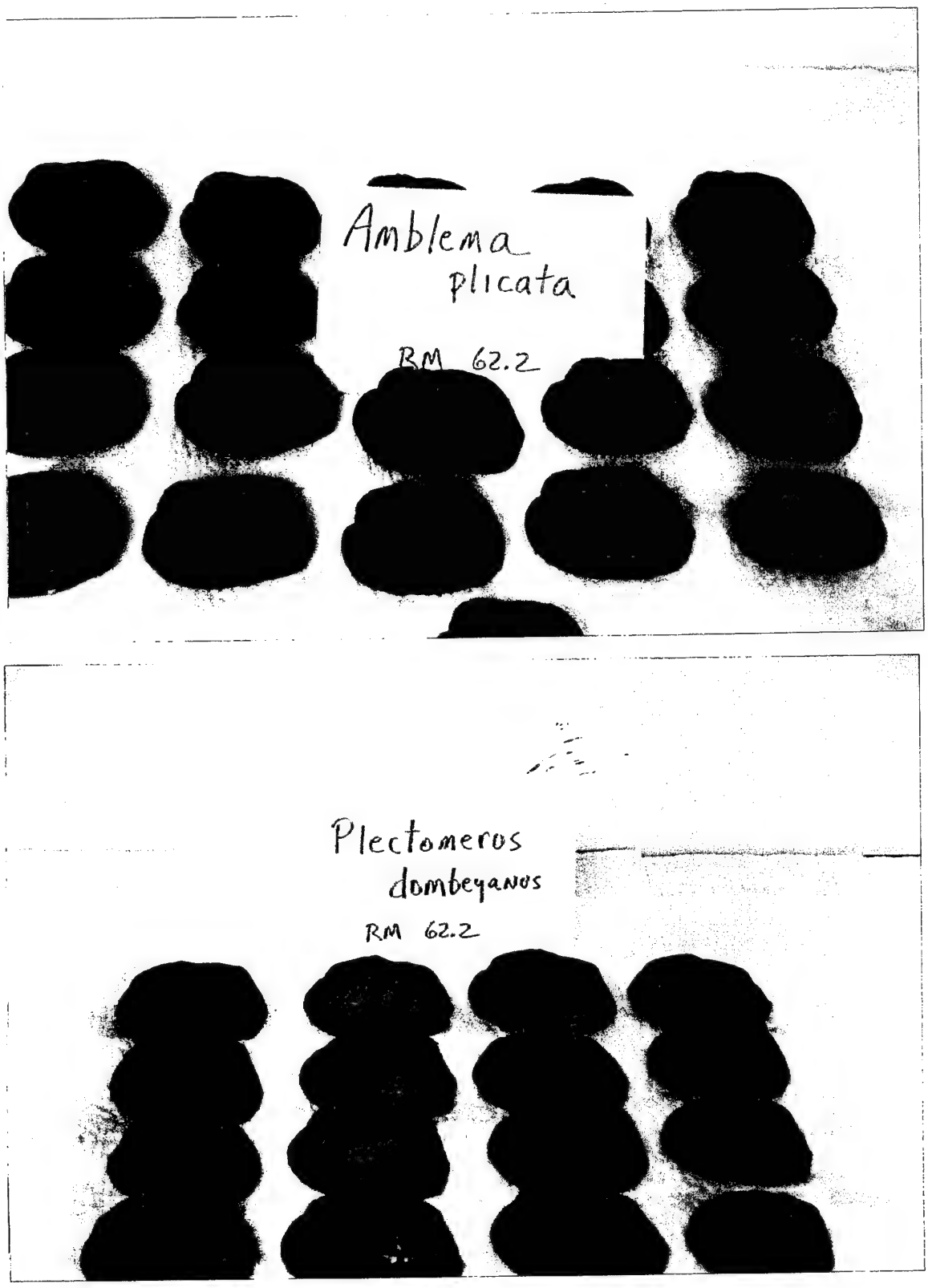

Figure 11. *Amblema plicata* and *Plectomerus dombeyanus* from RM 62.2 on Big Sunflower River, Mississippi

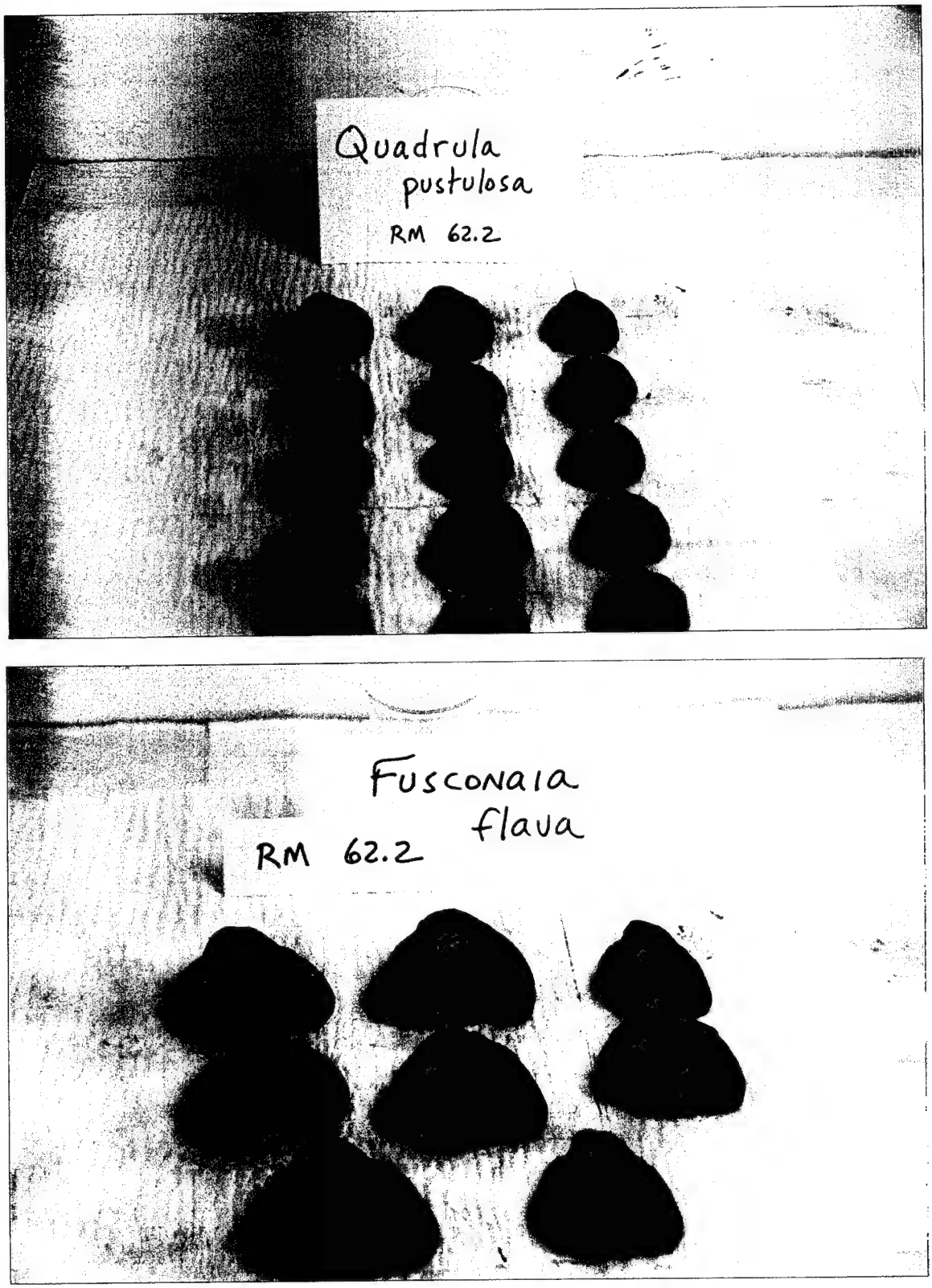

Figure 12. *Quadrula pustulosa* and *Fusconaia flava* from RM 62.2 on Big Sunflower River, Mississippi

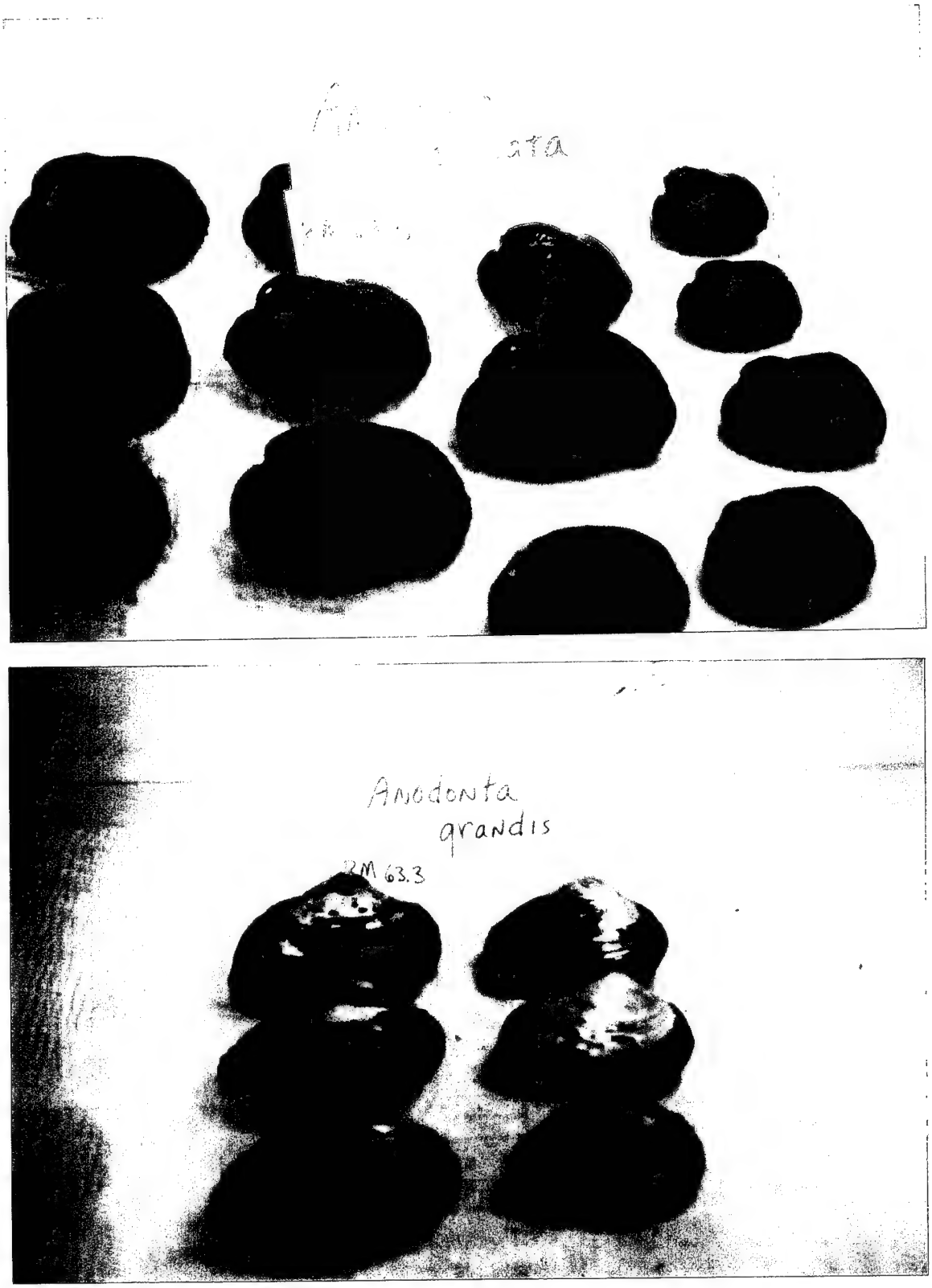

Figure 13. *Amblema plicata* and *Anodonta grandis* from RM 63.3 on Big Sunflower River, Mississippi

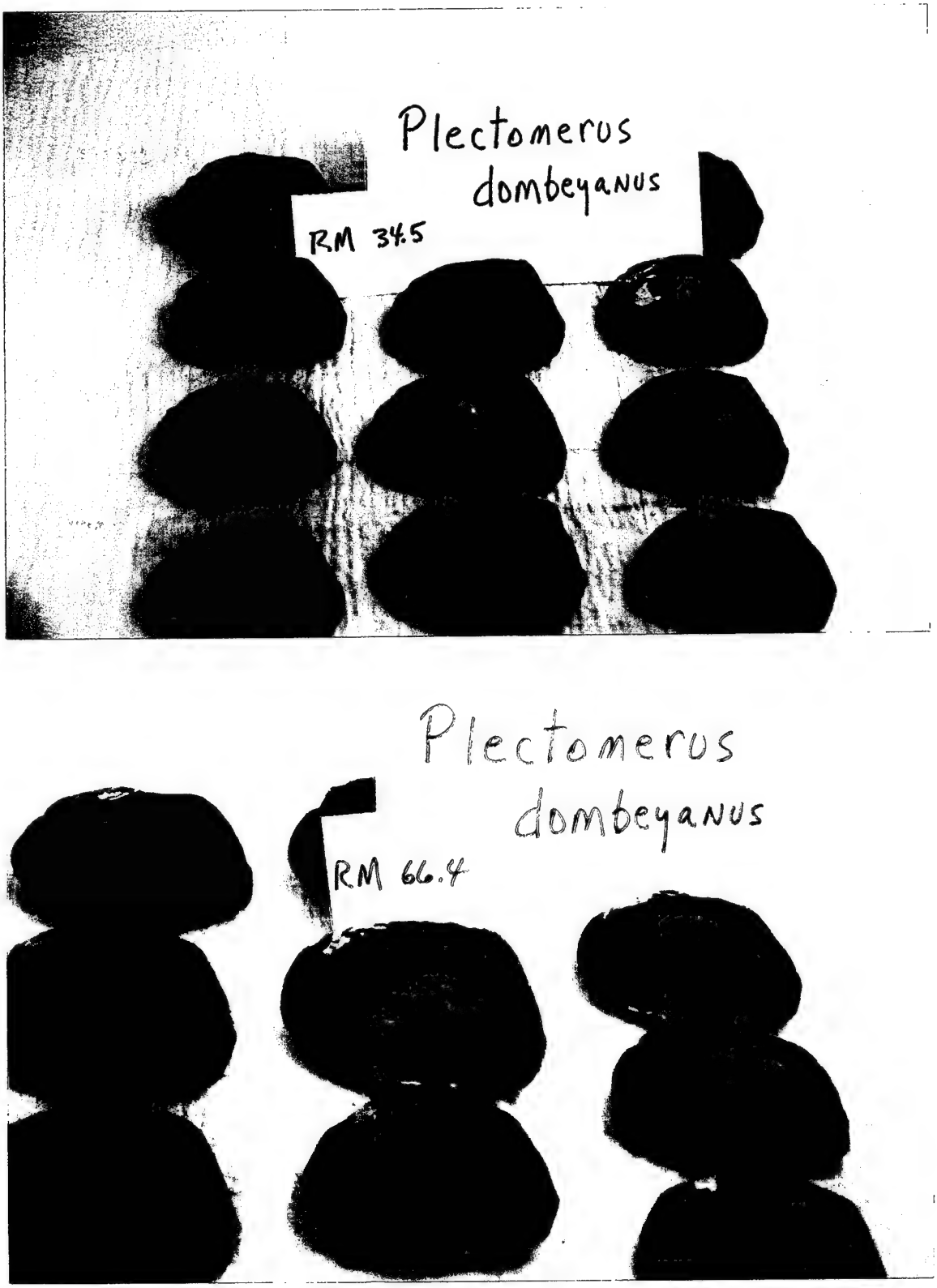

Figure 14. *Plectomerus dombeyanus* from RMs 34.5 and 66.4 on Big Sunflower River, Mississippi

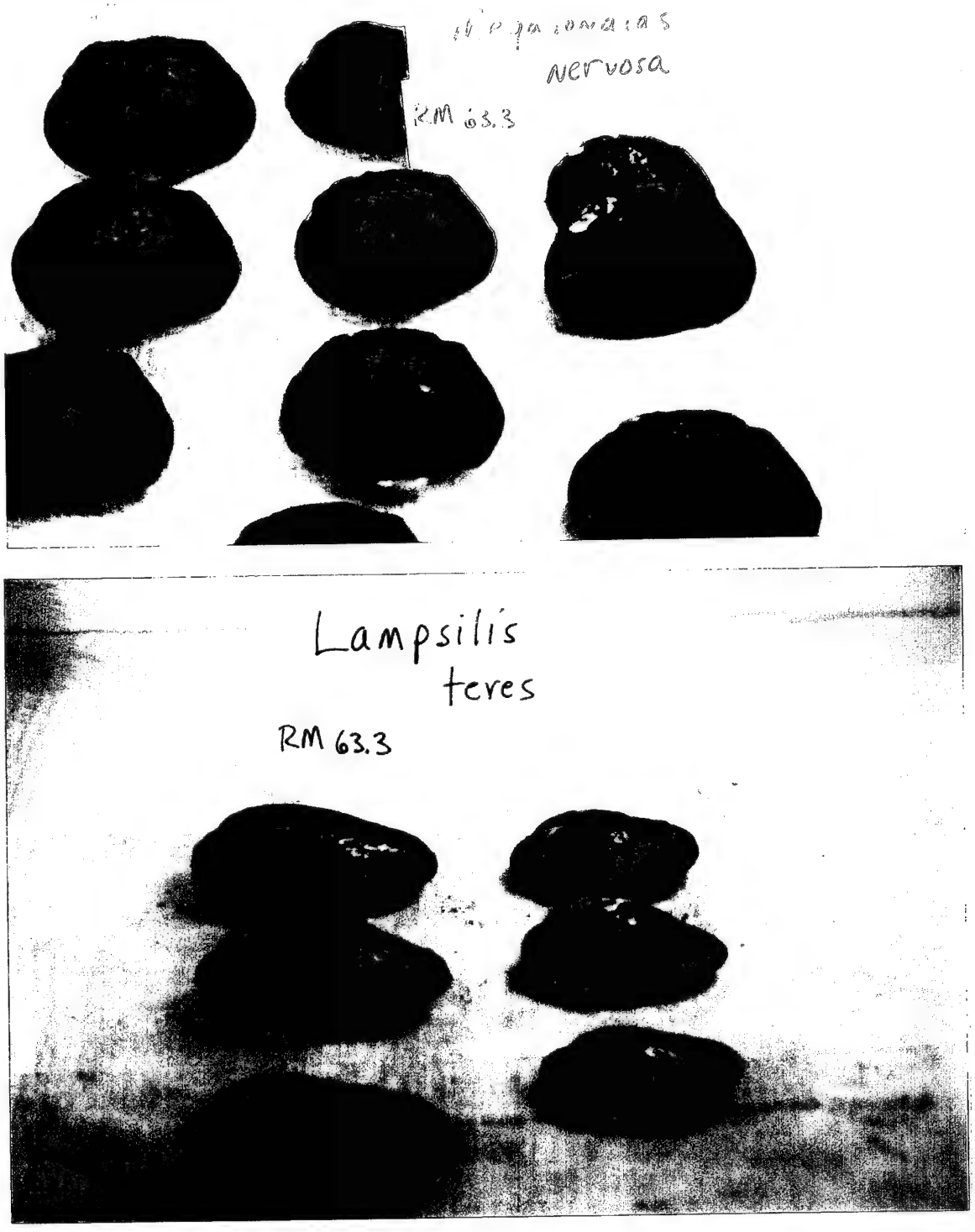

Figure 15. *Megalonaias nervosa* and *Lampsilis teres* from RM 63.3 on Big Sunflower River, Mississippi

Appendix A
Battelle Pacific Northwest Division Marine Sciences Laboratory Chemical Report, 20 January 1994

Battelle
Pacific Northwest Division

Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
Telephone (206) 683-4151
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January 20, 1994

Dr. Henry Tatem
Waterways Experiment Station
U. S. Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Dear Henry:

Enclosed are summary tables containing the final results of metals, pesticides and PCB analyses for mussel samples. Metals results are included for all 69 tissue samples. Pesticides and PCB results are provided for the first batch of 35 samples. Pesticides and PCB results for the second batch of 34 remaining tissues will be provided within the next two weeks. Also included with this report are QA/QC summaries outlining the methods used and brief discussions of the data quality objectives for this project.

If you have any questions please call me at 206-681-3626.

Very truly yours,

Lisa Lefkovitz
Environmental Chemist

:mkw

Enc.

QA/QC SUMMARY

PROGRAM: WES MUSSELS
PARAMETER: Metals
LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington
MATRIX: Tissue
SDG: 676WES

SAMPLE CUSTODY
A total of 69 mussel samples were received from WES on 11/18/93. Samples were received homogenized and an aliquot was subsampled into a clean tared Spex jar for metals analyses. Samples were assigned a Battelle Central File ID Number (676WES) and were logged into Battelles log-in system.

QA/QC DATA QUALITY OBJECTIVE

(mg/kg dry wt.)

	Method	Range of Recovery	SRM Accuracy	Relative Precision	Achieved Detection Limit
Arsenic	ICP/MS	75-125	≤20%	≤25%	0.908
Cadmium	ICP/MS	75-125	≤20%	≤25%	0.066
Chromium	ICP/MS	75-125	≤20%	≤25%	0.867
Copper	ICP/MS	75-125	≤20%	≤25%	0.788
Lead	ICP/MS	75-125	≤20%	≤25%	0.203
Mercury	CVAA	75-125	≤25%	≤25%	0.01
Nickel	ICP/MS	75-125	≤20%	≤25%	0.286
Selenium	ICP/MS	75-125	≤20%	≤25%	0.25
Zinc	ICP/MS	75-125	≤20%	≤25%	1.37

METHOD A total of thirteen (9) metals were analyzed for this project:arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), Selenium (Se) and zinc (Zn). Hg was analyzed using cold-vapor atomic absorption spectroscopy (CVAA) according to the method of Bloom and Crecelius (1983). The remaining metals were analyzed by inductively coupled plasma mass spectrometry (ICP/MS) following SOP MSL-M-025, Metals and Trace Elements in Sediment and Tissue by ICP/MS which is based on EPA method 200.8 (EPA 1991)

To prepare tissues for analysis, samples were freeze-dried and blended in a Spex mixer-mill. Approxiately 5 g of mixed sample was ground in a ceramic ball mill. For ICP/MS and CVAA analyses, 0.2- to 0.5-g aliquots of dried homogenous sample were digested using a mixture of nitric and perchloric acids.

HOLDING TIMES After samples were homogenized, tissue samples were frozen to -80°C and subsequently freeze dried within approximately 14 days of sample receipt. Samples were all analyzed within 180 days of receipt with the exception of Hg which was analyzed within 28 days of sample collection. The following summarizes the specific dates of each analysis:

Task	Date Performed
Sample Digestion	12/27/93
ICP-MS	1/12/93
CVAA-Hg	1/6/93

QA/QC NARRATIVE/ TISSUE METALS (continued)

DETECTION LIMITS MDLs were determined by multiplying the standard deviation of 3 replicate blank spike analyses by 3.5 to approximate the student t value. All samples contained metals concentrations above the MDLs with the exception of a number of Cr values.

METHOD BLANKS Four method blanks were analyzed with the samples. No metals were detected above the MDLs in any of the blanks.

MATRIX SPIKES Two samples were spiked with all metals. All recoveries were within the control limits of the 75-125% with the exception of one Zn spike recovery. This sample was spiked at a level 40 times below the native level in the sample making an accurate recovery difficult.

SRMs SRM, 1566a (an oyster tissue obtained from the National Institute for Standards and Technology, NIST), was analyzed in duplicate with the samples for all metals. All results were within 20% of the certified value with the exception of Cr, Cu and Ni in one of the SRMs. Cr results, however, are within the certified range of the SRM.

REFERENCES

Bloom, N. S., and E.A. Crecelius. 1983. "Determination of Mercury in Seawater at Sub-Nanogram per Liter Levels." Mar. Chem. 14:49-59.

EPA. 1991 Methods for the Determination of Metals in Environmental Samples. EPA-600/4-91-010. Environmental Services Division, Monitoring Management Branch.

MUSPCB.VAR

QA/QC SUMMARY

PROGRAM: WES
PARAMETER: Pesticides and Polychlorinated Biphenyl (PCB) Aroclors
LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington
MATRIX: Mussel Tissue/ BATCH 1

SAMPLE CUSTODY

A total of 69 mussel samples were received from WES on 11/18/93. All samples were received in good condition. Samples were assigned a Battelle Central File ID Numbers (676WES) and were logged into Battelles log-in system. This QA/QC summary covers batch 1 samples only.

QA/QC DATA QUALITY OBJECTIVES

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Detection Limit (dry wt)
PCB Cong.	GC/ECD	30-130%/ 50-150%	NA	≤30%	Pest - 0.5 ng/kg PCB - 5 µg/kg

METHOD

Tissue samples were extracted with methylene chloride using a roller under ambient conditions following SOP MSL-M-079, "Extraction and Clean-up of Sediment and Tissue for Semivolatile Organics following the Surrogate Internal Standard Method" based on EPA method 3510 and 8080 (EPA1986) and NOAA status and trends methodology (Krahn et al. 1988). Samples were then cleaned using Silica/Alumina (5% deactivated) chromatography followed by HPLC cleanup (Krahn et al. 1988). Extracts were analyzed using Gas Chromatography/Electron Capture Detection (GC/ECD) following SOP MSL-M-044, "Analysis of PCBs and Chlorinated Pesticides by GC/ECD" based on EPA method 8080 (1986). The column used was a J&W DB-17 and the confirmatory column was a DB-1701, both capillary columns (30m x 0.25mm I.D.).

MUSPCB.VAR

QA/QC NARRATIVE/ MUSSELS Pest/PCBs (continued)

HOLDING TIMES

Samples were received on 11/18/93 in good condition. Samples were logged into Battelle's log-in system and stored at approximately -20° C until extraction. Samples were extracted in two batches The first batch was extracted on 12/20/93. Extracts were analyzed by GC/ECD on 12/31/93, within the established holding time of 40 days from time of extraction (EPA 1986).

DETECTION LIMITS

All results are reported in µg/kg wet weight. (Percent moistures are also given.) Target detection limits of 0.5 µg/kg wet wt. for all pesticides and 5 µg/kg wet wt for PCB Aroclors were achieved. Method detection limits were determined from multiplying the standard deviation of 7 spiked replicates by the student-t value. No statistical MDLs have been detetrmined for Toxaphene, therefore the detection limit reported is based on the instrument detection limit.

METHOD BLANKS

One method blank was extracted with each extraction batch. No pesticides or PCBs were detected above the MDL in any of the blanks.

SURROGATES

Two compounds, PCB congeners 103 and 198, were added to all samples prior to extraction to assess the efficiency of the analysis. Sample surrogate recoveries for all samples were within the QC guidelines of 30-130% for both surrogates with the exception of PCB103 for one sample (611PNS*68). Except for the one surrogate recovery mentioned, all sample surrogate recoveries were within 50% of the recoveries of the SRM associated with the samples.

MUSPCB.VAR

QA/QC NARRATIVE/ MUSSELS Pest/PCBs (continued)

MATRIX SPIKES One sample from batch 1 was spiked in duplicate with 6 pesticides and with PCB Aroclor 1254. Matrix spike recoveries for all compounds were within the control limits of 50-150% with the exception of Aldrin which had recoveries of 218 and 238%. These high recoveries are due to some sort of matrix interference (since blank spike recoveries were acceptable, see below). Aldrin was only detected in one sample above the MDLs therefore, no corrective actions were taken.

BLANK SPIKES The method blank was also spiked in duplicate with 6 pesticides and Aroclor 1254 prior to extraction. Recoveries for all compounds were within the control limits of 50-150%.

SRMs No SRMs are presentely available for organics in tissue samples. We are waiting for re-certification of NISTs mussel tissue 1974.

REFERENCES

Krahn et al. "New HPLC Cleanup and Revised Extraction Procedures for Organic Contaminants," NOAA Technical Memorandum NMFS F/NWC-153. 1988.

U.S. Environmental Protection Agency (EPA). 1986. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. SW-846. U.S. Document No. 955-001-00000, U.S.E.P.A., Washington D.C.

1/20/94

USACE - WES/TATEM
METALS IN MUSSEL TISSUE SAMPLES
(CF #676WES)

(concentrations in µg/g)

MSL Code	Sponsor ID	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Se ICP/MS	Zn ICP/MS
676WES- 1	622AP01	6.91	0.373	1.37	5.65	0.089	2.32	0.320	2.35	332
676WES- 2	622AP03	5.73	0.341	1.26	5.33	0.088	2.04	0.243	2.84	308
676WES- 3	622AP06	5.97	0.334	1.29	5.28	0.020	2.14	0.251	2.92	364
676WES- 4	622PD01	6.20	0.218	1.12	5.61	0.091	1.45	0.254	2.86	153
676WES- 5	622PD03	6.01	0.240	1.24	5.35	0.071	1.69	0.323	3.00	188
676WES- 6	622PD05	7.73	0.277	1.14	6.17	0.073	2.03	0.303	2.63	245
676WES- 7	622QP01	4.90	0.915	2.10	5.42	0.120	1.64	0.322	3.01	172
676WES- 8	622QP02	4.91	0.945	1.89	5.12	0.123	1.67	0.258	2.73	191
676WES- 9	622QP03	5.06	1.01	1.84	5.20	0.128	1.49	0.352	2.75	144
676WES- 10	633AP02	4.92	0.436	1.45	4.77	0.117	1.99	0.407	2.20	260
676WES- 11	633AP03	5.22	0.306	0.867 U	5.63	0.083	1.57	0.269	2.31	188
676WES- 12	633AP05	4.38	0.349	1.15	5.46	0.080	1.65	0.326	2.54	193
676WES- 13	633AG01	9.14	0.797	1.63	4.76	0.090	4.17	1.26	3.04	423
676WES- 14	633AG02	7.40	0.794	0.867 U	5.76	0.062	4.24	0.637	2.48	234
676WES- 15	633AG03	11.2	1.15	1.35	6.52	0.072	6.71	0.911	3.08	410
676WES- 16	633PD01	5.66	0.419	1.40	5.98	0.085	2.82	0.477	3.02	224
676WES- 17	633PD03	6.60	0.537	1.24	6.36	0.114	3.45	0.619	2.45	270
676WES- 18	633PD04	7.36	0.332	1.96	7.60	0.104	3.28	0.669	2.64	314
676WES- 19	66RAP01	5.74	0.448	1.32	4.92	0.067	2.65	0.365	2.23	397
676WES- 20	664AP03	5.17	0.342	0.867 U	6.32	0.075	1.34	0.332	2.05	214
676WES- 21	664AP04	6.26	0.464	0.960	6.51	0.075	2.43	0.357	2.18	290
676WES- 22	664PD01	6.28	0.275	1.09	5.38	0.089	1.70	0.316	2.40	307
676WES- 23	664PD03	6.25	0.280	1.88	4.68	0.099	2.20	0.280	2.38	222
676WES- 24	664PD05	5.24	0.313	1.69	4.59	0.079	1.85	0.323	2.22	206
676WES- 25	345AP01	5.54	0.529	1.33	5.26	0.085	3.41	0.328	2.70	313
676WES- 26	345AP05	5.75	0.639	1.86	4.02	0.128	5.10	0.550	2.29	478
676WES- 27	345AP06	6.36	0.627	1.67	4.68	0.088	4.66	0.687	2.21	544
676WES- 28	345PD01	5.19	0.477	1.21	5.49	0.089	3.01	0.367	2.50	307
676WES- 29	345PD03	6.00	0.503	0.935	6.32	0.082	2.83	0.443	2.87	243

1/20/94

USACE - WES/TATEM
METALS IN MUSSEL TISSUE SAMPLES
(CF #676WES)

(concentrations in µg/g)

MSL Code	Sponsor ID	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Se ICP/MS	Zn ICP/MS
676WES- 30	345PD04	6.74	0.355	0.926	5.59	0.088	2.86	0.380	2.97	269
676WES- 31	345QP01	4.89	1.85	1.76	6.75	0.179	2.95	0.720	4.26	210
676WES- 32	345QP02	4.43	1.46	1.68	6.03	0.161	2.14	0.653	3.34	213
676WES- 33	345QP03	4.93	1.56	2.01	5.90	0.156	2.39	0.553	3.21	210
676WES- 34	140/150AP01	5.07	0.531	0.867 U	6.85	0.069	1.99	0.250	2.40	314
676WES- 35	140/150AP02	4.61	0.494	0.867 U	6.75	0.063	2.02	0.232	2.28	300
676WES- 36	140/15OAP03	4.82	0.756	0.867 U	7.29	0.084	2.70	0.398	2.22	377
676WES- 37	140/150PD01	5.51	0.304	0.867 U	5.65	0.079	1.68	0.298	2.30	143
676WES- 38	140/15OPD02	5.02	0.320	0.867 U	6.04	0.083	2.07	0.289	2.46	149
676WES- 39	140/150PD03	5.25	0.315	0.867 U	5.24	0.084	1.87	0.271	2.04	175
676WES- 40	140/150QP01	3.03	0.650	0.867 U	5.82	0.085	0.894	0.232	2.31	110
676WES- 41	140/150QP02	2.84	0.403	0.867 U	5.16	0.074	1.03	0.169	2.43	100
676WES- 42	140/150QP03	3.10	0.614	0.867 U	7.87	0.087	1.11	0.323	2.27	132
676WES- 43	760PP01	6.51	0.585	1.18	4.31	0.105	2.42	0.630	3.25	341
676WES- 44	760PP02	4.89	0.406	0.867 U	4.09	0.080	1.92	0.394	2.92	246
676WES- 45	760PP03	5.22	0.635	0.867 U	3.89	0.109	2.36	0.558	2.57	350
676WES- 46	760QP01	4.50	0.696	2.82	5.14	0.120	1.50	0.407	2.47	140
676WES- 47	760QP02	4.36	0.764	2.48	6.29	0.133	1.17	0.539	2.32	116
676WES- 48	760QP03	4.49	0.411	0.867 U	5.24	0.069	0.896	0.267	2.35	102
676WES- 49	633MN01	5.53	0.658	1.00	10.2	0.164	3.04	0.811	2.82	248
676WES- 50	633MN02	4.75	0.459	0.949	8.22	0.277	1.99	0.441	3.67	234
676WES- 51	633MN03	5.48	0.536	1.10	8.76	0.264	3.02	0.712	3.00	302
676WES- 52	760AP01	4.29	0.397	1.41	4.84	0.065	1.59	0.357	1.76	248
676WES- 53	760AP02	5.22	0.426	1.53	5.10	0.077	1.59	0.328	2.10	239
676WES- 54	760QP03	6.25	0.485	2.29	6.21	0.081	2.25	0.380	2.21	398
676WES- 55	792QP01	4.61	1.01	2.91	4.88	0.119	1.56	0.476	2.39	167
676WES- 56	792QP02	5.26	0.645	3.87	5.36	0.086	1.43	0.545	2.74	150
676WES- 57	792QP03	4.34	1.01	4.18	5.04	0.123	1.74	0.577	2.55	162
676WES- 58	792AP01	4.80	0.514	2.39	5.35	0.086	2.44	0.456	1.93	359

1/20/94

USACE - WES/TATEM
METALS IN MUSSEL TISSUE SAMPLES
(CF #676WES)

MSL Code	Sponsor ID	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Se ICP/MS	Zn ICP/MS
		(concentrations in µg/g)								
676WES- 59	792AP03	4.92	0.518	2.45	5.55	0.087	2.57	0.476	1.76	365
676WES- 60	792AP04	5.51	0.548	4.06	6.09	0.114	2.25	0.469	2.42	350
676WES- 61	792PD01	5.83	0.246	1.54	4.16	0.087	1.50	0.292	2.49	149
676WES- 62	792PD02	7.58	0.345	1.85	4.85	0.097	1.87	0.399	2.10	232
676WES- 63	792PD03	5.05	0.269	2.16	4.82	0.091	1.90	0.375	2.19	226
676WES- 64	633LT02	6.53	0.856	0.867 U	3.67	0.089	2.18	0.373	3.05	377
676WES- 65	633LT03	6.36	1.44	0.867 U	4.31	0.103	3.31	0.404	3.14	618
676WES- 66	633LT04	4.68	0.822	0.867 U	3.95	0.100	2.26	0.297	2.58	467
676WES- 67	664QP01	3.85	0.702	2.60	5.81	0.117	2.26	0.702	2.86	153
676WES- 68	664QP02	3.89	0.836	2.23	4.65	0.110	2.01	0.504	2.25	132
676WES- 69	664QP04	4.07	0.786	2.02	4.62	0.104	1.92	0.637	2.55	144
Blank-1		0.908 U	0.066 U	0.876 U	0.788 U	0.010 U	0.286 U	0.203 U	0.250 U	1.37 U
Blank-2		0.908 U	0.066 U	0.876 U	0.788 U	0.010 U	0.286 U	0.203 U	0.250 U	1.37 U
Blank-3		0.908 U	0.066 U	0.867 U	0.788 U	0.010 U	0.286 U	0.203 U	0.250 U	1.37 U
Blank-4		0.908 U	0.066 U	0.867 U	0.788 U	0.010 U	0.286 U	0.203 U	0.250 U	1.37 U
detection limits		0.908	0.066	0.867	0.788	0.010	0.286	0.203	0.250	1.37
STANDARD REFERENCE MATERIAL										
1566a-1		13.3	3.90	1.25	59.5	0.064	2.09	0.353	2.66	753
1566a-2		11.8	3.76	1.07 #	51.0 #	0.065	1.64 #	0.350	2.32	669
	certified value	14.0	4.15	1.43	66.3	0.0642	2.25	0.371	2.21	830
	range	±1.2	±0.38	±.46	±4.3	±0.0067	±0.44	±0.014	±0.24	±57

1/20/94

USACE - WES/TATEM
METALS IN MUSSEL TISSUE SAMPLES
(CF #676WES)

MSL Code	Sponsor ID	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Se ICP/MS	Zn ICP/MS
		(concentrations in µg/g)								
MATRIX SPIKE RESULTS										
Amount Spiked		5	5	5	5	5	5	5	5	5
676WES-33	345QP03	4.94	1.56	2.01	5.90	0.157	2.39	0.554	3.21	210
676WES-33 + Spike		9.62	6.12	6.37	9.89	4.08	6.47	5.30	7.47	211
Amount Recovered		4.68	4.56	4.36	3.99	3.92	4.08	4.75	4.26	1.00
Percent Recovery		94%	91%	87%	80%	78%	82%	95%	85%	20% *
Amount Spiked		5	5	5	5	5	5	5	5	5
676WES-56	792QP02	5.26	0.645	3.87	5.36	0.086	1.43	0.545	2.74	150
676WES-56 + Spike		9.62	5.15	8.18	9.30	5.19	5.43	5.42	7.19	156
Amount Recovered		4.36	4.51	4.31	3.94	5.10	4.00	4.88	4.45	6.00
Percent Recovery		87%	90%	86%	79%	102%	80%	98%	89%	120%

* = Recovery outside of control limits (±20%)
# = Recovery outside of control limits (75-125%)
U = Not detected at or below detection limits shown.
NA = Not applicable.

1/20/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 1

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	% Dry Weight	Wet Wt (g)	% Moisture	Surrogate Recoveries PCB 103	Surrogate Recoveries PCB 198	HEXA-CHLOR BENZENE	a-BHC	G-BHC	HEPTA-CHLOR	ALDRIN
676WES-	1 622AP01	1	12/20/93	18.28	21.20	81.72	19.7% *	13.8% *	0.68 U	0.24 U	0.11 U	0.07 U	0.09 U
676WES-	2 622AP03	1	12/20/93	19.12	20.90	80.88	77.6%	62.0%	0.69 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	3 622AP06	1	12/20/93	17.75	20.92	82.25	80.6%	62.8%	0.69 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	4 622PD01	1	12/20/93	18.34	20.53	81.66	72.6%	57.1%	0.71 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	5 622PD03	1	12/20/93	17.83	21.48	82.17	67.7%	50.3%	0.68 U	0.24 U	0.11 U	0.07 U	0.09 U
676WES-	6 622PD05	1	12/20/93	21.18	20.08	78.82	77.6%	60.6%	0.72 U	0.25 U	0.12 U	0.08 U	0.09 U
676WES-	7 622QP01	1	12/20/93	17.27	19.33	82.73	75.3%	59.8%	0.75 U	0.26 U	0.13 U	0.08 U	0.09 U
676WES-	8 622QP02	1	12/20/93	19.18	18.44	80.82	67.6%	54.4%	0.78 U	0.27 U	0.13 U	0.08 U	0.10 U
676WES-	9 622QP03	1	12/20/93	18.67	19.25	81.33	79.8%	62.3%	0.75 U	0.60 U	0.13 U	0.08 U	0.09 U
676WES-	10 633AP02	1	12/20/93	14.54	20.04	85.46	68.9%	53.7%	0.72 U	0.25 U	0.12 U	0.08 U	0.09 U
676WES-	11 633AP03	1	12/20/93	14.88	21.91	85.12	71.5%	56.9%	0.66 U	0.23 U	0.11 U	0.07 U	0.08 U
676WES-	12 633AP05	1	12/20/93	15.47	22.02	84.53	75.3%	60.5%	0.65 U	0.23 U	0.11 U	0.07 U	0.08 U
676WES-	13 633AG01	1	12/20/93	14.77	31.15	85.23	80.0%	60.2%	0.46 U	0.16 U	0.08 U	0.05 U	0.06 U
676WES-	14 633AG02	1	12/20/93	11.75	19.64	88.25	69.7%	53.2%	0.73 U	0.26 U	0.12 U	0.08 U	0.09 U
676WES-	15 633AG03	1	12/20/93	9.68	21.00	90.32	77.5%	56.0%	0.69 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	16 633PD01	1	12/20/93	16.09	20.79	83.91	71.9%	54.0%	0.69 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	17 633PD03	1	12/20/93	15.12	24.22	84.88	73.1%	54.4%	0.59 U	0.21 U	0.10 U	0.06 U	0.07 U
676WES-	18 633PD04	1	12/20/93	15.96	19.65	84.04	81.5%	61.7%	0.73 U	0.26 U	0.12 U	0.08 U	0.09 U
676WES-	19 66RAP01	1	12/20/93	19.03	20.93	80.97	70.9%	55.4%	37.6	0.24 U	2.02	2.35	5.95
676WES-	20 664AP03	1	12/20/93	16.31	24.71	83.69	67.2%	53.3%	0.58 U	0.20 U	0.10 U	0.06 U	0.07 U
676WES-	21 664AP04	1	12/20/93	18.55	20.75	81.45	72.1%	58.3%	0.69 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	22 664PD01	1	12/20/93	15.70	20.99	84.30	66.1%	57.7%	0.69 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	23 664PD03	1	12/20/93	14.87	20.19	85.13	69.3%	53.9%	0.72 U	0.25 U	0.12 U	0.08 U	0.09 U
676WES-	24 664PD05	1	12/20/93	13.32	22.97	86.68	67.1%	54.0%	0.63 U	0.22 U	0.11 U	0.07 U	0.08 U
676WES-	25 345AP01	1	12/20/93	14.91	20.78	85.09	69.4%	53.8%	0.69 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	26 345AP05	1	12/20/93	16.95	19.65	83.05	70.3%	55.0%	0.73 U	0.26 U	0.12 U	0.08 U	0.09 U
676WES-	27 345AP06	1	12/20/93	17.72	22.27	82.28	71.9%	57.1%	0.63 U	0.22 U	0.11 U	0.07 U	0.08 U
676WES-	28 345PD01	1	12/20/93	17.43	22.46	82.57	73.6%	60.0%	0.65 U	0.23 U	0.11 U	0.07 U	0.08 U
676WES-	29 345PD03	1	12/20/93	13.71	20.89	86.29	70.3%	55.8%	0.69 U	0.24 U	0.12 U	0.07 U	0.09 U
676WES-	30 345PD04	1	12/20/93	16.02	23.47	83.98	70.4%	60.1%	0.62 U	0.22 U	0.10 U	0.06 U	0.08 U
676WES-	31 345QP01	1	12/20/93	12.84	17.38	87.16	67.6%	53.3%	0.84 U	0.29 U	0.14 U	0.09 U	0.11 U
676WES-	32 345QP02	1	12/20/93	13.02	16.24	86.98	64.5%	53.0%	0.89 U	0.31 U	0.15 U	0.09 U	0.11 U
676WES-	33 345QP03	1	12/20/93	14.16	14.24	85.84	73.4%	60.4%	1.01 U	0.35 U	0.17 U	0.11 U	0.13 U
676WES-	34 140/150AP01	1	12/20/93	15.55	19.91	84.45	66.0%	54.9%	0.72 U	0.25 U	0.12 U	0.08 U	0.09 U
676WES-	35 140/150AP02	1	12/20/93	14.03	19.82	85.97	66.7%	57.5%	0.72 U	0.25 U	0.12 U	0.08 U	0.09 U
Blank-1		1	12/20/93	NA	NA	NA	62.1%	68.4%	0.72 U	0.25 U	0.12 U	0.08 U	0.09 U
Blank-2		1	12/20/93	NA	NA	NA	62.1%	57.4%	0.72 U	0.25 U	0.12 U	0.08 U	0.09 U

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USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 1

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	% Dry Weight	Wet Wt (g)	% Moisture	Surrogate Recoveries PCB 103	Surrogate Recoveries PCB 198	HEXACHLOR BENZENE	a-BHC	G-BHC	HEPTACHLOR	ALDRIN
BLANK SPIKE RESULTS													
Amount Spiked									NS	NS	2.50	2.50	2.50
Blank-1		1	12/20/93	NA	NA	NA	62.1%	68.4%	NS	NS	0.12 U	0.08 U	0.09 U
Blank-1 + Spike 1		1	12/20/93	NA	NA	NA	72.0%	64.4%	NS	NS	1.93	2.22	2.08
Amount Recovered									NS	NS	1.93	2.22	2.08
Percent Recovery									NS	NS	77%	89%	83%
Amount Spiked									NS	NS	2.50	2.50	2.50
Blank-1		1	12/20/93	NA	NA	NA	62.1%	68.4%	NS	NS	0.12 U	0.08 U	0.09 U
Blank-1 + Spike 2		1	12/20/93	NA	NA	NA	65.9%	60.6%	NS	NS	2.01	2.28	2.14
Amount Recovered									NS	NS	2.01	2.28	2.14
Percent Recovery									NS	NS	80%	91%	86%
MATRIX SPIKE RESULTS													
Amount Spiked									NS	NS	2.50	2.50	2.50
676WES-11	633AP03	1	12/20/93	14.88	21.91	85.12	71.5%	56.9%	NS	NS	0.11 U	0.07 U	0.08 U
676WES-11 + Spike 1		1	12/20/93	NA	20.93	NA	74.4%	58.1%	NS	NS	2.02	2.36	5.44
Amount Recovered									NS	NS	2.02	2.36	5.44
Percent Recovery									NS	NS	81%	94%	218% #
Amount Spiked									NS	NS	2.50	2.50	2.50
676WES-11	633AP03	1	12/20/93	14.88	21.91	85.12	71.5%	56.9%	NS	NS	0.11 U	0.07 U	0.08 U
676WES-11 + Spike 2		1	12/20/93	NA	21.54	NA	70.9%	55.4%	NS	NS	2.02	2.35	5.95
Amount Recovered									NS	NS	2.02	2.35	5.95
Percent Recovery									NS	NS	81%	94%	238% #

U = Not detected at or above the detection limit shown
NA = Not applicable.
NS = Not spiked.
* = Outside QC criteria (30-150%).
# = Outside QC criteria (50-120%).

1/20/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 1

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	b-BHC	D-BHC	HEPTACHLOR EPOXIDE	2,4'-DDE	ENDO-SULFAN I	g-CHLOR-DANE	a-CHLOR-DANE	TRANS NONACHLOR
676WES-	1 622AP01	1	12/20/93	0.24 U	0.24 U	0.23 U	0.06 U	0.24 U	1.06	0.58	0.85
676WES-	2 622AP03	1	12/20/93	0.24 U	0.24 U	0.24 U	0.07 U	0.24 U	1.13	0.71	0.06 U
676WES-	3 622AP06	1	12/20/93	0.24 U	0.24 U	0.51	0.07 U	0.24 U	0.95	0.57	0.06 U
676WES-	4 622PD01	1	12/20/93	0.25 U	0.25 U	0.62	0.07 U	0.25 U	1.46	0.88	0.06 U
676WES-	5 622PD03	1	12/20/93	0.24 U	0.24 U	0.64	0.06 U	0.24 U	1.65	1.03	0.06 U
676WES-	6 622PD05	1	12/20/93	0.25 U	0.25 U	0.64	0.07 U	0.25 U	1.40	0.90	0.06 U
676WES-	7 622QP01	1	12/20/93	0.26 U	0.26 U	0.57	0.07 U	0.26 U	0.87	0.48	0.26
676WES-	8 622QP02	1	12/20/93	0.27 U	0.27 U	0.26 U	0.07 U	0.27 U	1.10	0.42	0.07 U
676WES-	9 622QP03	1	12/20/93	0.26 U	0.26 U	0.61	0.07 U	0.26 U	0.99	0.57	0.34
676WES-	10 633AP02	1	12/20/93	0.25 U	0.25 U	0.45	0.07 U	0.25 U	0.63	0.38	0.06 U
676WES-	11 633AP03	1	12/20/93	0.23 U	0.23 U	0.53	0.06 U	0.23 U	0.86	0.56	0.06 U
676WES-	12 633AP05	1	12/20/93	0.23 U	0.23 U	0.53	0.06 U	0.23 U	1.01	0.60	0.05 U
676WES-	13 633AG01	1	12/20/93	0.16 U	0.16 U	0.16 U	0.04 U	0.16 U	0.58	0.34	0.04 U
676WES-	14 633AG02	1	12/20/93	0.26 U	0.26 U	0.48	0.07 U	0.26 U	0.71	0.40	0.06 U
676WES-	15 633AG03	1	12/20/93	0.24 U	0.24 U	0.24 U	0.07 U	0.24 U	0.62	0.36	0.06 U
676WES-	16 633PD01	1	12/20/93	0.24 U	0.24 U	0.52	0.07 U	0.24 U	0.81	0.45	0.06 U
676WES-	17 633PD03	1	12/20/93	0.21 U	0.10 U	0.47	0.06 U	0.21 U	0.92	0.44	0.27
676WES-	18 633PD04	1	12/20/93	0.26 U	0.26 U	0.58	0.07 U	0.26 U	0.88	0.53	0.29
676WES-	19 66RAP01	1	12/20/93	0.24 U	0.24 U	0.24 U	0.07 U	0.24 U	0.24 U	0.62	0.06 U
676WES-	20 664AP03	1	12/20/93	0.20 U	0.20 U	0.47	0.05 U	0.20 U	2.19	0.75	0.05 U
676WES-	21 664AP04	1	12/20/93	0.24 U	0.24 U	0.24 U	0.07 U	0.24 U	1.00	0.30	0.06 U
676WES-	22 664PD01	1	12/20/93	0.24 U	0.24 U	0.24 U	0.07 U	0.24 U	0.67	0.54	0.23
676WES-	23 664PD03	1	12/20/93	0.25 U	0.25 U	0.24 U	0.07 U	0.25 U	0.54	0.36	0.06 U
676WES-	24 664PD05	1	12/20/93	0.22 U	0.22 U	0.46	0.06 U	0.23	0.63	0.48	0.05 U
676WES-	25 345AP01	1	12/20/93	0.24 U	0.24 U	0.24 U	0.07 U	0.24 U	1.06	0.57	0.29
676WES-	26 345AP05	1	12/20/93	0.26 U	0.26 U	0.25 U	0.07 U	0.26 U	0.26 U	0.30	0.06 U
676WES-	27 345AP06	1	12/20/93	0.22 U	0.22 U	0.22 U	0.06 U	0.22 U	0.72	0.40	0.05 U
676WES-	28 345PD01	1	12/20/93	0.23 U	0.23 U	0.22 U	0.06 U	0.23	1.23	0.57	0.28
676WES-	29 345PD03	1	12/20/93	0.24 U	0.24 U	0.24 U	0.07 U	0.31	1.24	0.65	0.34
676WES-	30 345PD04	1	12/20/93	0.22 U	0.22 U	0.21 U	0.06 U	0.25	1.33	0.68	0.34
676WES-	31 345QP01	1	12/20/93	0.29 U	0.29 U	0.28 U	0.08 U	0.29 U	0.29 U	0.36	0.07 U
676WES-	32 345QP02	1	12/20/93	0.31 U	0.31 U	0.67	0.08 U	0.31 U	0.31 U	0.40	0.08 U
676WES-	33 345QP03	1	12/20/93	0.35 U	0.35 U	0.34 U	0.10 U	0.35 U	0.35 U	0.43	0.08 U
676WES-	34 140/150AP01	1	12/20/93	0.25 U	0.25 U	0.24 U	0.07 U	0.43	0.58	0.71	0.08 U
676WES-	35 140/150AP02	1	12/20/93	0.25 U	0.25 U	0.24 U	0.07 U	0.35	0.50	0.62	0.06 U
Blank-1		1	12/20/93	0.25 U	0.25 U	0.24 U	0.07 U	0.25 U	0.25 U	0.06 U	0.06 U
Blank-2		1	12/20/93	0.25 U	0.25 U	0.24 U	0.07 U	0.25 U	0.25 U	0.06 U	0.06 U

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USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 1

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	b-BHC	D-BHC	HEPTACHLOR EPOXIDE	2,4'-DDE	ENDO-SULFAN I	g-CHLOR-DANE	a-CHLOR-DANE	TRANS NONACHLOR
BLANK SPIKE RESULTS											
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	NS
Blank-1		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	NS
Blank-1 + Spike 1		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	NS
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	NS
Blank-1		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	NS
Blank-1 + Spike 2		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	NS
MATRIX SPIKE RESULTS											
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	NS
676WES-11	633AP03	1	12/20/93	NS	NS	NS	NS	NS	NS	NS	NS
676WES-11 + Spike 1		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	NS
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	NS
676WES-11	633AP03	1	12/20/93	NS	NS	NS	NS	NS	NS	NS	NS
676WES-11 + Spike 2		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	NS

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* = Outside QC criteria (30-150%).
# = Outside QC criteria (50-120%).

1/20/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 1

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	4,4'-DDE	DIELDRIN	2,4'-DDD	ENDRIN	2,4'-DDT	4,4'-DDD	ENDO-SULFAN II	4,4'-DDT	ENDRIN ALDEHYDE
676WES-	1 622AP01	1	12/20/93	114	2.61	6.10	0.24 U	0.21 U	65.4	1.19	3.67	0.24 U
676WES-	2 622AP03	1	12/20/93	103	2.90	7.04	0.24 U	0.21 U	68.8	1.52	4.35	0.24 U
676WES-	3 622AP06	1	12/20/93	90.3	2.47	6.28	0.24 U	0.21 U	61.8	1.28	3.62	0.24 U
676WES-	4 622PD01	1	12/20/93	126	3.63	9.97	0.25 U	0.21 U	80.5	2.02	7.04	0.25 U
676WES-	5 622PD03	1	12/20/93	141	4.10	11.5	0.24 U	0.21 U	89.8	2.44	11.3	0.24 U
676WES-	6 622PD05	1	12/20/93	125	3.57	9.26	0.25 U	0.22 U	79.8	2.14	11.7	0.25 U
676WES-	7 622QP01	1	12/20/93	70.2	1.96	4.73	0.26 U	0.23 U	44.9	0.86	1.56	0.26 U
676WES-	8 622QP02	1	12/20/93	77.4	2.05	4.92	0.27 U	0.24 U	50.1	0.91	1.65	0.27 U
676WES-	9 622QP03	1	12/20/93	78.5	2.26	5.90	0.26 U	0.23 U	52.7	1.07	1.97	0.26 U
676WES-	10 633AP02	1	12/20/93	65.2	1.66	3.81	0.25 U	0.22 U	45.4	0.56	0.73	0.25 U
676WES-	11 633AP03	1	12/20/93	83.4	2.38	6.52	0.23 U	0.20 U	62.1	1.04	1.76	0.23 U
676WES-	12 633AP05	1	12/20/93	91.6	2.61	7.22	0.23 U	0.20 U	66.7	1.10	2.22	0.23 U
676WES-	13 633AG01	1	12/20/93	61.9	1.51	5.35	0.16 U	0.14 U	39.3	0.67	1.20	0.16 U
676WES-	14 633AG02	1	12/20/93	92.6	1.85	6.40	0.26 U	0.22 U	53.8	0.74	1.31	0.26 U
676WES-	15 633AG03	1	12/20/93	87.6	1.64	5.18	0.24 U	0.21 U	50.9	0.70	0.71	0.24 U
676WES-	16 633PD01	1	12/20/93	71.2	1.86	3.83	0.24 U	0.21 U	47.6	0.77	1.10	0.24 U
676WES-	17 633PD03	1	12/20/93	77.9	2.08	4.43	0.21 U	0.18 U	52.0	1.00	1.74	0.21 U
676WES-	18 633PD04	1	12/20/93	76.9	2.07	4.49	0.26 U	0.22 U	53.2	1.01	2.91	0.26 U
676WES-	19 66RAP01	1	12/20/93	80.0	10.8	6.40	0.24 U	0.21 U	59.7	0.24 U	11.8	0.24 U
676WES-	20 664AP03	1	12/20/93	178	5.44	14.0	0.20 U	0.18 U	112	1.79	2.73	0.20 U
676WES-	21 664AP04	1	12/20/93	102	2.75	6.89	0.24 U	0.21 U	70.6	0.74	0.73	0.24 U
676WES-	22 664PD01	1	12/20/93	65.8	2.02	3.98	0.24 U	0.21 U	49.9	0.79	1.02	0.24 U
676WES-	23 664PD03	1	12/20/93	62.3	1.82	3.56	0.25 U	0.22 U	47.8	0.58	0.18 U	0.25 U
676WES-	24 664PD05	1	12/20/93	57.3	1.88	3.73	0.22 U	0.19 U	46.5	0.74	1.20	0.22 U
676WES-	25 345AP01	1	12/20/93	88.4	2.20	5.04	0.24 U	0.21 U	56.5	0.95	1.46	0.24 U
676WES-	26 345AP05	1	12/20/93	50.3	1.30	2.52	0.26 U	0.22 U	31.9	0.43	0.18 U	0.26 U
676WES-	27 345AP06	1	12/20/93	70.3	1.67	3.89	0.22 U	0.19 U	45.8	0.64	0.63	0.22 U
676WES-	28 345PD01	1	12/20/93	95.2	2.45	5.99	0.23 U	0.20	63.1	1.03	1.87	0.23 U
676WES-	29 345PD03	1	12/20/93	109	2.68	6.51	0.24 U	0.21 U	66.6	1.11	1.51	0.24 U
676WES-	30 345PD04	1	12/20/93	111	2.90	6.95	0.22 U	0.19 U	69.6	1.27	2.26	0.22 U
676WES-	31 345QP01	1	12/20/93	66.7	1.74	3.22	0.29 U	0.25 U	39.0	0.61	0.72	0.29 U
676WES-	32 345QP02	1	12/20/93	67.3	1.80	3.35	0.31 U	0.27 U	40.3	0.61	0.22 U	0.31 U
676WES-	33 345QP03	1	12/20/93	75.4	2.02	3.67	0.35 U	0.31 U	43.1	0.73	0.95	0.35 U
676WES-	34 140/150AP01	1	12/20/93	43.4	3.10	2.72	0.25 U	1.07	21.8	1.21	1.11	0.25 U
676WES-	35 140/150AP02	1	12/20/93	45.0	2.71	2.25	1.88	0.79	20.7	0.92	0.76	0.25 U
Blank-1		1	12/20/93	0.07 U	0.16 U	0.20 U	0.25 U	0.22 U	0.23 U	0.25 U	0.18 U	0.25 U
Blank-2		1	12/20/93	0.07 U	0.16 U	0.20 U	0.25 U	0.22 U	0.23 U	0.25 U	0.18 U	0.25 U

1/20/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 1

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	4,4'-DDE	DIELDRIN	2,4'-DDD	ENDRIN	2,4'-DDT	4,4'-DDD	ENDO-SULFAN II	4,4'-DDT	ENDRIN ALDEHYDE
BLANK SPIKE RESULTS												
Amount Spiked				NS	10.0	NS	10.0	10.0	NS	NS	NS	NS
Blank-1		1	12/20/93	NS	0.16 U	NS	0.25 U	0.22 U	NS	NS	NS	NS
Blank-1 + Spike 1		1	12/20/93	NS	8.86	NS	9.45	10.4	NS	NS	NS	NS
Amount Recovered				NS	8.86	NS	9.45	10.4	NS	NS	NS	NS
Percent Recovery				NS	89%	NS	95%	104%	NS	NS	NS	NS
Amount Spiked				NS	10.0	NS	10.0	10.0	NS	NS	NS	NS
Blank-1		1	12/20/93	NS	0.16 U	NS	0.25 U	0.22 U	NS	NS	NS	NS
Blank-1 + Spike 2		1	12/20/93	NS	9.28	NS	9.85	10.9	NS	NS	NS	NS
Amount Recovered				NS	9.28	NS	9.85	10.9	NS	NS	NS	NS
Percent Recovery				NS	93%	NS	99%	109%	NS	NS	NS	NS
MATRIX SPIKE RESULTS												
Amount Spiked				NS	10.0	NS	10.0	10.0	NS	NS	NS	NS
676WES-11	633AP03	1	12/20/93	NS	2.38	NS	0.23 U	0.20 U	NS	NS	NS	NS
676WES-11 + Spike 1		1	12/20/93	NS	10.7	NS	10.4	11.5	NS	NS	NS	NS
Amount Recovered				NS	8.32	NS	10.4	11.5	NS	NS	NS	NS
Percent Recovery				NS	83%	NS	104%	115%	NS	NS	NS	NS
Amount Spiked				NS	10.0	NS	10.0	10.0	NS	NS	NS	NS
676WES-11	633AP03	1	12/20/93	NS	2.38	NS	0.23 U	0.20 U	NS	NS	NS	NS
676WES-11 + Spike 2		1	12/20/93	NS	10.8	NS	10.5	11.8	NS	NS	NS	NS
Amount Recovered				NS	8.42	NS	10.5	11.8	NS	NS	NS	NS
Percent Recovery				NS	84%	NS	105%	118%	NS	NS	NS	NS

U = Not detected at or above the detection limit shown
NA = Not applicable.
NS = Not spiked.
* = Outside QC criteria (30-150%).
# = Outside QC criteria (50-120%).

1/20/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 1

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	MIREX	ENDO-SULFAN SULFATE	METH-OXYCLOR	ENDRIN KETONE	TOXAPHENE	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	AROCLOR 1260
676WES-	1 622AP01	1	12/20/93	0.24 U	3.96	0.06 U	0.24 U	245	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	2 622AP03	1	12/20/93	0.24 U	4.35	0.06 U	0.24 U	282	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	3 622AP06	1	12/20/93	0.24 U	3.67	0.06 U	0.24 U	253	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	4 622PD01	1	12/20/93	0.25 U	5.59	0.06 U	0.25 U	359	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	5 622PD03	1	12/20/93	0.24 U	6.27	0.06 U	0.24 U	407	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	6 622PD05	1	12/20/93	0.25 U	5.58	0.06 U	0.25 U	369	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	7 622QP01	1	12/20/93	0.26 U	2.63	0.06 U	0.47	182	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	8 622QP02	1	12/20/93	0.27 U	2.84	0.07 U	0.27 U	209	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	9 622QP03	1	12/20/93	0.26 U	3.15	0.06 U	0.26 U	212	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	10 633AP02	1	12/20/93	0.25 U	2.21	0.06 U	0.25 U	167	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	11 633AP03	1	12/20/93	0.23 U	3.14	0.06 U	0.23 U	213	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	12 633AP05	1	12/20/93	0.23 U	3.53	0.05 U	0.23 U	248	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	13 633AG01	1	12/20/93	0.16 U	1.98	0.04 U	0.16 U	151	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	14 633AG02	1	12/20/93	0.26 U	1.69	0.06 U	0.26 U	187	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	15 633AG03	1	12/20/93	0.24 U	1.99	0.06 U	0.24 U	165	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	16 633PD01	1	12/20/93	0.24 U	2.17	0.06 U	0.24 U	180	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	17 633PD03	1	12/20/93	0.21 U	2.68	0.05 U	0.21 U	198	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	18 633PD04	1	12/20/93	0.26 U	2.56	0.06 U	0.26 U	210	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	19 66RAP01	1	12/20/93	0.24 U	2.92	0.06 U	0.24 U	177	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	20 664AP03	1	12/20/93	0.20 U	7.15	0.05 U	0.20 U	435	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	21 664AP04	1	12/20/93	0.24 U	3.33	0.06 U	0.24 U	234	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	22 664PD01	1	12/20/93	0.24 U	2.59	0.06 U	0.24 U	180	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	23 664PD03	1	12/20/93	0.25 U	2.07	0.06 U	0.25 U	182	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	24 664PD05	1	12/20/93	0.22 U	2.23	0.05 U	0.22 U	183	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	25 345AP01	1	12/20/93	0.24 U	3.03	0.06 U	0.24 U	209	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	26 345AP05	1	12/20/93	0.26 U	1.89	0.06 U	0.26 U	96.7	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	27 345AP06	1	12/20/93	0.22 U	2.55	0.05 U	0.22 U	156	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	28 345PD01	1	12/20/93	0.23 U	3.49	0.05 U	0.23 U	236	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	29 345PD03	1	12/20/93	0.24 U	3.67	0.06 U	0.24 U	250	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	30 345PD04	1	12/20/93	0.22 U	4.03	0.05 U	0.22 U	269	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	31 345QP01	1	12/20/93	0.29 U	2.06	0.07 U	0.29 U	138	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	32 345QP02	1	12/20/93	0.31 U	2.21	0.08 U	0.31 U	143	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	33 345QP03	1	12/20/93	0.35 U	2.35	0.08 U	0.35 U	148	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	34 140/150AP01	1	12/20/93	0.25 U	9.54	0.06 U	0.25 U	166	5.00 U	5.00 U	5.00 U	5.00 U
676WES-	35 140/150AP02	1	12/20/93	0.25 U	7.43	0.06 U	0.25 U	153	5.00 U	5.00 U	5.00 U	5.00 U
Blank-1		1	12/20/93	0.25 U	0.25 U	0.06 U	0.25 U	10.0 U	5.00 U	5.00 U	5.00 U	5.00 U
Blank-2		1	12/20/93	0.25 U	0.25 U	0.06 U	0.25 U	10.0 U	5.00 U	5.00 U	5.00 U	5.00 U

1/20/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 1

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	MIREX	ENDO-SULFAN SULFATE	METH-OXYCLOR	ENDRIN KETONE	TOXAPHENE	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	AROCLOR 1260
BLANK SPIKE RESULTS												
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	50.0	NS
Blank-1		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	5.00 U	NS
Blank-1 + Spike 1		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	51.4	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	51.4	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	103%	NS
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	50.0	NS
Blank-1		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	5.00 U	NS
Blank-1 + Spike 2		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	52.9	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	52.9	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	106%	NS
MATRIX SPIKE RESULTS												
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	50.0	NS
676WES-11	633AP03	1	12/20/93	NS	NS	NS	NS	NS	NS	NS	5.00 U	NS
676WES-11 + Spike 1		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	60.0	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	60.0	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	120%	NS
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	50.0	NS
676WES-11	633AP03	1	12/20/93	NS	NS	NS	NS	NS	NS	NS	5.00 U	NS
676WES-11 + Spike 2		1	12/20/93	NS	NS	NS	NS	NS	NS	NS	60.0	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	60.0	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	120%	NS

U = Not detected at or above the detection limit show
NA = Not applicable.
NS = Not spiked.
* = Outside QC criteria (30-150%).
# = Outside QC criteria (50-120%).

Appendix B
Battelle Pacific Northwest Division Marine Sciences Laboratory Chemical Report, 16 February 1994 and 25 March 1994

Battelle
Pacific Northwest Division

Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
Telephone (206) 683-4151
Facsimile (206) 681-3699

February 16, 1994

Dr. Henry Tatem
Waterways Experiment Station
U. S. Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Dear Henry:

Enclosed are summary tables containing the final results for pesticides and PCBs for the second batch of 34 remaining tissues. Included with this report are QA/QC summaries outlining the methods used and brief discussions of the data quality objectives for this project. Also enclosed is a computer disk with data for PCB/pests for batch 2 in a LOTUS123 format. This should conclude the deliverables for this project.

If you have any questions please call me at 206-681-3626.

Very truly yours,

Lisa Lefkovitz
Environmental Chemist

:mkw

Enc.

MUSPCB.VAR

QA/QC SUMMARY - FEBRUARY 15, 1994

PROGRAM: WES
PARAMETER: Pesticides and Polychlorinated Biphenyl (PCB) Aroclors
LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington
MATRIX: Mussel Tissue/ BATCH 2

SAMPLE CUSTODY

A total of 69 mussel samples were received from WES on 11/18/93. All samples were received in good condition. Samples were assigned a Battelle Central File ID Numbers (676WES) and were logged into Battelles log-in system. This QA/QC summary covers batch 2 samples only.

QA/QC DATA QUALITY OBJECTIVES

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Detection Limit (dry wt)
PCB Cong.	GC/ECD	30-130%/ 50-150%	NA	≤30%	Pest - 0.5 ng/kg PCB - 5 µg/kg

METHOD

Tissue samples were extracted with methylene chloride using a roller under ambient conditions following SOP MSL-M-079, "Extraction and Clean-up of Sediment and Tissue for Semivolatile Organics following the Surrogate Internal Standard Method" based on EPA method 3510 and 8080 (EPA1986) and NOAA status and trends methodology (Krahn et al. 1988). Samples were then cleaned using Silica/Alumina (5% deactivated) chromatography followed by HPLC cleanup (Krahn et al. 1988). Extracts were analyzed using Gas Chromatography/Electron Capture Detection (GC/ECD) following SOP MSL-M-044, "Analysis of PCBs and Chlorinated Pesticides by GC/ECD" based on EPA method 8080 (1986). The column used was a J&W DB-17 and the confirmatory column was a DB-1701, both capillary columns (30m x 0.25mm I.D.).

MUSPCB.VAR

QA/QC NARRATIVE/ MUSSELS Pest/PCBs (continued)

HOLDING TIMES

Samples were received on 11/18/93 in good condition. Samples were logged into Battelle's log-in system and stored at approximately -20° C until extraction. Samples were extracted in two batches The second batch was extracted on 1/5/94. Extracts were analyzed by GC/ECD on 1/27/94, within the established holding time of 40 days from time of extraction (EPA 1986).

DETECTION LIMITS

All results are reported in µg/kg wet weight. (Percent moistures are also given.) Method detection limits ranged from 0.5 to 5 µg/kg wet wt. for all pesticides and 28 µg/kg wet wt for PCB Aroclors. Method detection limits were determined from multiplying the standard deviation of 7 spiked replicates by the student-t value. No statistical MDLs have been detetrmined for Toxaphene, therefore the detection limit reported is based on the instrument detection limit. Note that the detection limits reported with batch 2 are approximately a factor of 2.5 higher than those reported for batch 1. This is a result of injection of less of the sample extract onto the GC to attempt to eliminate further dilutions. This step was taken based on the high levels of certain pesticides detected in mussels from the first batch.

METHOD BLANKS

Two method blanks were extracted with this extraction batch. No pesticides or PCBs were detected above the MDL in any of the blanks with the exception of endrin ketone in one of the blanks. All endrin ketone results in samples associated with the blank were flagged with a B if the concentrations were less than 5 times those detected in the blank.

MUSPCB.VAR

QA/QC NARRATIVE/ MUSSELS Pest/PCBs (continued)

SURROGATES Two compounds, PCB congeners 103 and 198, were added to all samples prior to extraction to assess the efficiency of the analysis. Sample surrogate recoveries for all samples were within the QC guidelines of 30-130% for both surrogates with the exception of PCB103 for a number of samples. This was due to intermittant co-elution of PCB 103 with g-BHC. When this happened the recovery of PCB 103 was not used to quantify sample results. g-BHC values in these cases were taken from the rear confirmation column.

MATRIX SPIKES One sample from batch 2 was spiked in duplicate with 6 pesticides and with PCB Aroclor 1254. Matrix spike recoveries for all compounds were within the control limits of 50-150% with the exception of g-BHC in both the spike and spike duplicate. The g-BHC recoveries may be low due to coelution problems on the column which appear to be accentuated by the matrix as blank spike recoveries for g-BHC were good (see below).

BLANK SPIKES The method blank was also spiked in duplicate with 6 pesticides and Aroclor 1254 prior to extraction. Recoveries for all compounds were within the control limits of 50-150%.

SRMs No SRMs are presently available for organics in tissue samples. We are waiting for re-certification of NISTs mussel tissue 1974.

REFERENCES

Krahn et al. "New HPLC Cleanup and Revised Extraction Procedures for Organic Contaminants," NOAA Technical Memorandum NMFS F/NWC-153. 1988.

U.S. Environmental Protection Agency (EPA). 1986. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. SW-846. U.S. Document No. 955-001-00000, U.S.E.P.A., Washington D.C.

3/25/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 2

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	% Dry Weight	Wet Wt (g)	Surrogate Recoveries PCB 103	PCB 198	HEXA-CHLOR BENZENE	a-BHC	G-BHC	HEPTA-CHLOR	ALDRIN
676WES- 36	140/150AP03	2	1/5/94	12.84	20.29	86%	68%	0.711 U	0.248 U	0.119 U	0.074 U	0.962
676WES- 37	140/150PD01	2	1/5/94	13.11	20.30	82%	75%	0.709 U	0.246 U	0.119 U	0.341	0.089
676WES- 38	140/150PD02	2	1/5/94	11.90	20.40	89%	77%	0.706 U	0.245 U	0.118 U	0.074 U	0.089
676WES- 39	140/150PD03	2	1/5/94	14.41	20.70	101%	73%	0.694 U	0.242 U	0.117 U	0.072 U	0.088
676WES- 40	140/150QP01	2	1/5/94	17.95	20.05	97%	70%	0.716 U	0.250 U	0.120 U	0.075 U	0.090
676WES- 41	140/150QP02	2	1/5/94	17.42	20.09	108%	76%	0.718 U	0.249 U	0.120 U	0.075 U	1.16
676WES- 42	140/150QP03	2	1/5/94	18.32	18.04	91%	61%	0.799 U	0.278 U	0.134 U	0.672	0.101
676WES- 43	760PP01	2	1/5/94	15.46	25.81	604% *	66%	0.557 U	0.193 U	0.093 U	0.386	4.65
676WES- 44	760PP02	2	1/5/94	13.77	25.64	1004% *	73%	0.562 U	0.196 U	0.094 U	0.059 U	4.06
676WES- 45	760PP03	2	1/5/94	14.59	20.69	506% *	70%	0.696 U	0.242 U	0.117 U	0.073 U	2.55
676WES- 46	760QP01	2	1/5/94	19.13	20.85	113%	65%	0.690 U	0.241 U	0.117 U	0.073 U	2.95
676WES- 47	760QP02	2	1/5/94	16.95	20.43	125%	63%	0.708 U	0.246 U	0.119 U	0.075 U	3.31
676WES- 48	760QP03	2	1/5/94	17.84	20.62	73%	61%	0.699 U	0.243 U	0.118 U	0.073 U	3.78
676WES- 49	633MN01	2	1/5/94	15.89	22.52	539% *	61%	0.639 U	0.222 U	0.106 U	0.067 U	0.081
676WES- 50	633MN02	2	1/5/94	17.63	21.14	740% *	85%	0.682 U	0.238 U	0.115 U	0.072 U	0.086
676WES- 51	633MN03	2	1/5/94	17.93	20.29	1030% *	72%	0.710 U	0.247 U	0.118 U	0.073 U	0.090
676WES- 52	760AP01	2	1/5/94	16.15	10.83	76%	68%	0.693 U	24.1 U	0.116 U	0.073 U	0.087
676WES- 53	760AP02	2	1/5/94	15.76	20.78	80%	67%	0.692 U	0.241 U	0.117 U	0.073 U	0.088
676WES- 54	760QP03	2	1/5/94	19.51	22.20	108%	70%	0.650 U	0.226 U	0.109 U	0.068 U	0.082
676WES- 55	792QP01	2	1/5/94	15.69	21.00	100%	70%	0.684 U	0.239 U	0.115 U	0.056 U	4.72
676WES- 56	792QP02	2	1/5/94	17.84	20.38	120%	72%	0.708 U	0.246 U	0.120 U	0.498	0.089
676WES- 57	792QP03	2	1/5/94	16.13	20.65	103%	77%	0.699 U	0.244 U	0.118 U	0.073 U	4.34
676WES- 58	792AP01	2	1/5/94	21.70	20.39	101%	78%	0.705 U	0.245 U	0.119 U	0.074 U	0.089
676WES- 59	792AP03	2	1/5/94	18.20	20.72	144%	80%	0.695 U	0.242 U	0.116 U	0.073 U	0.087
676WES- 60	792AP04	2	1/5/94	16.09	21.18	114%	75%	0.679 U	0.236 U	0.114 U	0.071 U	0.085
676WES- 61	792PD01	2	1/5/94	16.67	20.93	57%	44%	0.660 U	0.230 U	0.110 U	0.068 U	0.083
676WES- 62	792PD02	2	1/5/94	16.39	22.27	88%	71%	0.647 U	0.225 U	0.108 U	0.067 U	0.082
676WES- 63	792PD03	2	1/5/94	15.09	20.77	110%	80%	0.693 U	0.241 U	0.116 U	0.072 U	1.12
676WES- 64	633LT02	2	1/5/94	13.83	20.72	345% *	77%	0.697 U	0.242 U	0.118 U	0.073 U	0.089
676WES- 65	633LT03	2	1/5/94	10.94	23.11	223% *	68%	0.626 U	0.218 U	0.105 U	0.066 U	0.079
676WES- 66	633LT04	2	1/5/94	13.41	20.78	338% *	70%	0.693 U	0.241 U	0.117 U	0.072 U	0.087
676WES- 67	664QP01	2	1/5/94	15.98	15.58	104%	81%	0.922 U	0.321 U	0.155 U	0.096 U	0.117
676WES- 68	664QP02	2	1/5/94	17.01	20.49	114%	75%	0.703 U	0.245 U	0.117 U	0.073 U	0.088
676WES- 69	664QP04	2	1/5/94	15.00	23.07	97%	73%	0.624 U	0.217 U	0.105 U	0.066 U	0.079
Blank-1		2	1/5/94	15.00	NA	62%	73%	0.720 U	0.250 U	0.120 U	0.075 U	0.091
Blank-2		2	1/5/94	15.00	NA	52%	68%	0.720 U	0.250 U	0.120 U	0.075 U	0.091

3/25/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 2

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	% Dry Weight	Wet Wt (g)	% Moisture	Surrogate Recoveries PCB 103	PCB 198	HEXA-CHLOR BENZENE	a-BHC	G-BHC	HEPTA-CHLOR	ALDRIN
BLANK SPIKE RESULTS													
Amount Spiked									NS	NS	2.50	2.50	2.50
Blank-1		2	1/5/94	15.00	NA	NA	62%	73%	NS	NS	0.120 U	0.075 U	0.091
Blank-1 + Spike 1		2	1/5/94	15.00	NA	NA	64%	77%	NS	NS	2.25	1.68	1.75
Amount Recovered									NS	NS	2.25	1.68	1.75
Percent Recovery									NS	NS	90%	67%	70%
Amount Spiked									NS	NS	2.50	2.50	2.50
Blank-1		2	1/5/94	15.00	NA	NA	62%	73%	NS	NS	0.120 U	0.075 U	0.091
Blank-1 + Spike 2		2	1/5/94	15.00	NA	NA	60%	70%	NS	NS	2.53	1.84	1.89
Amount Recovered									NS	NS	2.53	1.84	1.89
Percent Recovery									NS	NS	101%	74%	75%
MATRIX SPIKE RESULTS													
Amount Spiked									50.2	NS	2.52	2.52	2.52
676WES- 1	792PD03	2	1/5/94	15.09	20.77	99.85	110%	80%	0.693 U	NS	0.116 U	0.072 U	1.12
676WES-63 + Spike 1		2	1/5/94	15.09	20.00	NA	81%	71%	33.6	NS	0.949	2.22	2.54
Amount Recovered									33.6	NS	0.949	2.22	2.54
Percent Recovery									67%	NS	38% #	88%	101%
Amount Spiked									50.2	NS	2.52	2.52	2.52
676WES- 1	792PD03	2	1/5/94	15.09	20.77	99.85	110%	80%	0.693 U	NS	0.116 U	0.072 U	1.12
676WES-63 + Spike 2		2	1/5/94	15.09	20.26	NA	81%	71%	33.3	NS	0.611	2.29	2.61
Amount Recovered									33.3	NS	0.611	2.29	2.61
Percent Recovery									66%	NS	24% #	91%	104%

U = Not detected at or above the detection limit shown
D = Sample results taken from diluted extract (1:10)
NA = Not applicable
NC = Not certified
NS = Not spiked
* = PCB 103 co-eluted with g-BHC. This surrogate was not used in quantitation.
# = Outside QC criteria (50-150%)
B = Values detected in samples were <5 x the levels found in associated blank.

3/25/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 2

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	b-BHC	D-BHC	HEPTACHLOR EPOXIDE	2,4'-DDE	ENDO-SULFAN I	g-CHLOR-DANE	a-CHLOR-DANE	TRANS NONACHLOR
676WES- 36	140/15OAP03	2	1/5/94	0.248 U	0.248 U	0.243 U	0.068 U	0.248 U	0.248 U	0.529	0.060 U
676WES- 37	140/150PD01	2	1/5/94 U	0.246 U	0.246 U	0.241 U	0.067 U	0.380	0.427	0.535	0.060 U
676WES- 38	140/15OPD02	2	1/5/94 U	0.245	0.245 U	0.240 U	0.067 U	0.484	0.536	0.661	0.060 U
676WES- 39	140/150PD03	2	1/5/94 U	0.242 U	0.242 U	0.236 U	0.066 U	0.242 U	0.645	0.772	0.664
676WES- 40	140/150QP01	2	1/5/94 U	0.250 U	0.250 U	0.244 U	0.068 U	0.250 U	0.420	0.548	0.061 U
676WES- 41	140/150QP02	2	1/5/94	0.249 U	0.249 U	0.244 U	0.068 U	0.476	0.510	0.592	0.486
676WES- 42	140/150QP03	2	1/5/94 U	0.278 U	0.278 U	0.271 U	0.075 U	0.278 U	0.762	0.850	0.068 U
676WES- 43	760PP01	2	1/5/94	0.193 U	0.193 U	0.189 U	0.053 U	0.193 U	0.320	0.490	0.046 U
676WES- 44	760PP02	2	1/5/94	0.196 U	0.196 U	0.191 U	0.054 U	0.196 U	0.196 U	0.340	0.295
676WES- 45	760PP03	2	1/5/94	0.242 U	0.242 U	0.236 U	0.066 U	0.242 U	0.242 U	0.191	0.058 U
676WES- 46	760QP01	2	1/5/94	0.241 U	0.241 U	0.235 U	0.065 U	0.241 U	0.295	0.329	0.287
676WES- 47	760QP02	2	1/5/94	0.246 U	0.246 U	0.241 U	0.068 U	0.246 U	0.347	0.437	0.412
676WES- 48	760QP03	2	1/5/94	0.243 U	0.280 U	0.237 U	0.066 U	0.243 U	0.257	0.348	0.293
676WES- 49	633MN01	2	1/5/94 U	0.222 U	0.222 U	0.218 U	0.060 U	0.222 U	0.431	0.574	0.054 U
676WES- 50	633MN02	2	1/5/94 U	0.238 U	0.238 U	0.233 U	0.065 U	0.238 U	0.400	0.538	0.479
676WES- 51	633MN03	2	1/5/94 U	0.247 U	0.247 U	0.242 U	0.068 U	0.247 U	0.418	0.651	0.059 U
676WES- 52	760AP01	2	1/5/94 U	0.241 U	0.241 U	0.236 U	0.066 U	0.241 U	0.241 U	0.325	0.287
676WES- 53	760AP02	2	1/5/94 U	0.241 U	0.241 U	0.235 U	0.066 U	0.241 U	0.262	0.410	0.336
676WES- 54	760QP03	2	1/5/94 U	0.226 U	0.226 U	0.220 U	0.062 U	0.226 U	0.376	0.486	0.449
676WES- 55	792QP01	2	1/5/94	0.239 U	0.238 U	0.232 U	0.064 U	0.239 U	0.510	0.468	0.395
676WES- 56	792QP02	2	1/5/94 U	0.246 U	0.246 U	0.241 U	0.068 U	0.246 U	0.494	0.491	0.437
676WES- 57	792QP03	2	1/5/94	0.244 U	0.244 U	0.237 U	0.066 U	0.376	0.345	0.340	0.323
676WES- 58	792AP01	2	1/5/94 U	0.245 U	0.245 U	0.241 U	0.067 U	0.245 U	0.347	0.460	0.417
676WES- 59	792AP03	2	1/5/94 U	0.242 U	0.242 U	0.237 U	0.066 U	0.242 U	0.533	0.564	0.557
676WES- 60	792AP04	2	1/5/94 U	0.236 U	0.237 U	0.230 U	0.064 U	0.236 U	0.236 U	0.315	0.253
676WES- 61	792PD01	2	1/5/94 U	0.230 U	0.230 U	0.225 U	0.063 U	0.230 U	0.682	0.577	0.567
676WES- 62	792PD02	2	1/5/94 U	0.225 U	0.225 U	0.220 U	0.061 U	0.225 U	0.342	0.413	0.359
676WES- 63	792PD03	2	1/5/94	0.241 U	0.241 U	0.235 U	0.066 U	0.241 U	0.625	0.631	0.607
676WES- 64	633LT02	2	1/5/94 U	0.242 U	0.242 U	0.237 U	0.066 U	0.242 U	0.242 U	0.331	0.297
676WES- 65	633LT03	2	1/5/94 U	0.218 U	0.218 U	0.212 U	0.059 U	0.218 U	0.265	0.349	0.309
676WES- 66	633LT04	2	1/5/94 U	0.241 U	0.241 U	0.236 U	0.066 U	0.241 U	0.377	0.426	0.432
676WES- 67	664QP01	2	1/5/94 U	0.321 U	0.321 U	0.313 U	0.088 U	0.321 U	0.387	0.467	0.369
676WES- 68	664QP02	2	1/5/94 U	0.245 U	0.245 U	0.240 U	0.066 U	0.245 U	0.327	0.398	0.339
676WES- 69	664QP04	2	1/5/94 U	0.217 U	0.218 U	0.211 U	0.058 U	0.217 U	0.264	0.312	0.270
Blank-1		2	1/5/94 U	0.250 U	0.250 U	0.244 U	0.067 U	0.250 U	0.250 U	0.063 U	0.060 U
Blank-2		2	1/5/94 U	0.250 U	0.250 U	0.244 U	0.067 U	0.250 U	0.250 U	0.063 U	0.060 U

3/25/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 2

(concentrations in µg/kg wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date		b-BHC	D-BHC	HEPTACHLOR EPOXIDE	2,4'-DDE	ENDO-SULFAN I	g-CHLOR-DANE	a-CHLOR-DANE	TRANS NONACHLOR
BLANK SPIKE RESULTS												
Amount Spiked					NS	NS	NS	NS	NS	NS	NS	NS
Blank-1		2	1/5/94	U	NS	NS	NS	NS	NS	NS	NS	NS
Blank-1 + Spike 1		2	1/5/94		NS	NS	NS	NS	NS	NS	NS	NS
Amount Recovered					NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovery					NS	NS	NS	NS	NS	NS	NS	NS
Amount Spiked					NS	NS	NS	NS	NS	NS	NS	NS
Blank-1		2	1/5/94	U	NS	NS	NS	NS	NS	NS	NS	NS
Blank-1 + Spike 2		2	1/5/94		NS	NS	NS	NS	NS	NS	NS	NS
Amount Recovered					NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovery					NS	NS	NS	NS	NS	NS	NS	NS
MATRIX SPIKE RESULTS												
Amount Spiked					NS	NS	NS	NS	NS	NS	NS	NS
676WES- 1	792PD03	2	1/5/94		NS	NS	NS	NS	NS	NS	NS	NS
676WES-63 + Spike 1		2	1/5/94		NS	NS	NS	NS	NS	NS	NS	NS
Amount Recovered					NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovery					NS	NS	NS	NS	NS	NS	NS	NS
Amount Spiked					NS	NS	NS	NS	NS	NS	NS	NS
676WES- 1	792PD03	2	1/5/94		NS	NS	NS	NS	NS	NS	NS	NS
676WES-63 + Spike 2		2	1/5/94		NS	NS	NS	NS	NS	NS	NS	NS
Amount Recovered					NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovery					NS	NS	NS	NS	NS	NS	NS	NS

U = Not detected at or above the detection limit shown
D = Sample results taken from diluted extract (1:10)
NA = Not applicable
NC = Not certified
NS = Not spiked
* = PCB 103 co-eluted with g-BHC. This surrogate was not used in quantitation.
# = Outside QC criteria (50-150%)
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3/25/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 2

(concentrations in µg/g wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	4,4'-DDE	DIELDRIN	2,4'-DDD	ENDRIN	2,4'-DDT	4,4'-DDD	ENDO-SULFAN II	4,4'-DDT	ENDRIN ALDEHYDE
676WES- 36	140/15OAP03	2	1/5/94	34.5	2.27	2.50	0.248 U	0.217 U	12.4	0.630	1.35	0.248 U
676WES- 37	140/150PD01	2	1/5/94	34.7	2.79	2.82	0.246 U	0.216 U	14.2	0.693	1.49	0.246 U
676WES- 38	140/15OPD02	2	1/5/94	55.2	3.84	4.37	0.245 U	0.215 U	26.9	0.968	2.23	0.245 U
676WES- 39	140/150PD03	2	1/5/94	55.2	4.34	4.86	0.242 U	0.212 U	26.1	1.26	3.00	0.242 U
676WES- 40	140/150QP01	2	1/5/94	37.2	2.77	2.66	0.250 U	0.217 U	13.8	0.770	1.94	0.250 U
676WES- 41	140/150QP02	2	1/5/94	43.0	3.55	3.45	0.249 U	0.218 U	16.9	0.892	1.86	0.249 U
676WES- 42	140/150QP03	2	1/5/94	68.3	4.54	4.67	1.942	0.244 U	25.8	0.476	0.198 U	0.278 U
676WES- 43	760PP01	2	1/5/94	58.3	0.124 U	7.30	0.193 U	0.170 U	54.6	0.983	4.28	0.193 U
676WES- 44	760PP02	2	1/5/94	57.0	0.124 U	6.47	0.198 U	0.171 U	48.3	0.779	5.19	0.196 U
676WES- 45	760PP03	2	1/5/94	43.5	0.153 U	3.63	0.242 U	0.212 U	29.5	0.375	1.71	0.242 U
676WES- 46	760QP01	2	1/5/94	53.7	0.153 U	4.72	0.241 U	0.210 U	33.5	1.16	6.98	0.241 U
676WES- 47	760QP02	2	1/5/94	68.5	0.156 U	6.25	0.246 U	0.215 U	45.6	1.38	6.37	0.246 U
676WES- 48	760QP03	2	1/5/94	60.3	0.155 U	4.64	0.243 U	0.212 U	38.9	0.482	1.48 B	0.243 U
676WES- 49	633MN01	2	1/5/94	98.2 D	0.141 U	13.3	0.222 U	0.194 U	51.0 D	2.07	20.3 D	0.222 U
676WES- 50	633MN02	2	1/5/94	108 D	0.152 U	14.5	0.238 U	0.208 U	55.2 D	1.70	16.7	0.238 U
676WES- 51	633MN03	2	1/5/94	118 D	0.156 U	15.5	0.247 U	0.217 U	62.9 D	2.42	28.5	0.247 U
676WES- 52	760AP01	2	1/5/94	52.5	0.153 U	4.34	0.241 U	0.212 U	36.3	0.636	2.10	0.241 U
676WES- 53	760AP02	2	1/5/94	64.0	0.153 U	5.26	0.241 U	0.225 U	45.7	0.768	2.63	0.241 U
676WES- 54	760QP03	2	1/5/94	89.1	0.142 U	7.86	0.226 U	0.197 U	64.2	1.10	5.46	0.226 U
676WES- 55	792QP01	2	1/5/94	67.2	0.151 U	5.40	0.239 U	0.209 U	40.8	0.750	2.06	0.239 U
676WES- 56	792QP02	2	1/5/94	80.3	0.157 U	7.89	0.246 U	0.216 U	58.4	1.06	3.59	0.246 U
676WES- 57	792QP03	2	1/5/94	58.6	0.155 U	5.61	0.244 U	0.213 U	37.3	0.721	1.90	0.244 U
676WES- 58	792AP01	2	1/5/94	69.0	0.156 U	6.25	0.245 U	0.215 U	49.3	0.812	2.28	0.245 U
676WES- 59	792AP03	2	1/5/94	83.9	0.153 U	7.90	0.242 U	0.211 U	61.5	1.22	11.4	0.242 U
676WES- 60	792AP04	2	1/5/94	52.6	0.150 U	4.78	0.236 U	0.206 U	36.2	0.656	2.27	0.236 U
676WES- 61	792PD01	2	1/5/94	84.7	0.145 U	7.03	0.230 U	0.202 U	56.2	1.19	7.17	0.230 U
676WES- 62	792PD02	2	1/5/94	70.1	0.143 U	6.39	0.225 U	0.197 U	48.7	0.621	1.87	0.225 U
676WES- 63	792PD03	2	1/5/94	93.9	0.152 U	8.77	0.979	0.211 U	67.1	1.32	6.40	0.241 U
676WES- 64	633LT02	2	1/5/94	66.0	3.55	4.79	0.242 U	0.212 U	38.7	0.390	3.57	0.242 U
676WES- 65	633LT03	2	1/5/94	60.1	3.99	4.15	0.218 U	0.190 U	35.9	0.457	1.85	0.218 U
676WES- 66	633LT04	2	1/5/94	72.8	3.94	5.23	0.241 U	0.210 U	44.5	0.644	2.84	0.241 U
676WES- 67	664QP01	2	1/5/94	90.9	0.204 U	6.55	0.321 U	0.281 U	51.9	0.906	0.228 U	0.321 U
676WES- 68	664QP02	2	1/5/94	82.5	0.155 U	7.13	0.245 U	0.214 U	55.3	0.890	0.174 U	0.245 U
676WES- 69	664QP04	2	1/5/94	51.3	0.138 U	3.69	0.217 U	0.190 U	27.9	0.444	1.22 B	0.217 U
Blank-1		2	1/5/94	0.069 U	0.159 U	0.201 U	0.250 U	0.219 U	0.234 U	0.250 U	0.316	0.250 U
Blank-2		2	1/5/94	0.069 U	0.159 U	0.201 U	0.250 U	0.219 U	0.234 U	0.250 U	0.177 U	0.250 U

3/25/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 2

(concentrations in µg/g wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	4,4'-DDE	DIELDRIN	2,4'-DDD	ENDRIN	2,4'-DDT	4,4'-DDD	ENDO-SULFAN II	4,4'-DDT	ENDRIN ALDEHYDE
BLANK SPIKE RESULTS												
Amount Spiked				NS	10.0	NS	10.0	NS	NS	NS	10.0	NS
Blank-1		2	1/5/94	NS	0.159 U	NS	0.250 U	NS	NS	NS	0.316	NS
Blank-1 + Spike 1		2	1/5/94	NS	7.63	NS	8.41	NS	NS	NS	8.34	NS
Amount Recovered				NS	7.63	NS	8.41	NS	NS	NS	8.02	NS
Percent Recovery				NS	76%	NS	84%	NS	NS	NS	80%	NS
Amount Spiked				NS	10.0	NS	10.0	NS	NS	NS	10.0	NS
Blank-1		2	1/5/94	NS	0.159 U	NS	0.250 U	NS	NS	NS	0.316	NS
Blank-1 + Spike 2		2	1/5/94	NS	8.07	NS	9.00	NS	NS	NS	9.12	NS
Amount Recovered				NS	8.07	NS	9.00	NS	NS	NS	8.80	NS
Percent Recovery				NS	81%	NS	90%	NS	NS	NS	88%	NS
MATRIX SPIKE RESULTS												
Amount Spiked				NS	10.1	NS	10.1	NS	NS	NS	10.1	NS
676WES- 1	792PD03	2	1/5/94	NS	0.1524 U	NS	0.979	NS	NS	NS	6.40	NS
676WES-63 + Spike 1		2	1/5/94	NS	12.4	NS	9.84	NS	NS	NS	16.7	NS
Amount Recovered				NS	12.4	NS	8.86	NS	NS	NS	10.4	NS
Percent Recovery				NS	123%	NS	88%	NS	NS	NS	103%	NS
Amount Spiked				NS	10.1	NS	10.1	NS	NS	NS	10.1	NS
676WES- 1	792PD03	2	1/5/94	NS	0.1524 U	NS	0.979	NS	NS	NS	6.40	NS
676WES-63 + Spike 2		2	1/5/94	NS	11.9	NS	10.1	NS	NS	NS	15.7	NS
Amount Recovered				NS	11.9	NS	9.13	NS	NS	NS	9.30	NS
Percent Recovery				NS	118%	NS	91%	NS	NS	NS	92%	NS

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# = Outside QC criteria (50-150%)
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3/25/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 2

(concentrations in µg/g wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	ENDO-SULFAN SULFATE	METH-OXYCLOR	MIREX	ENDRIN KETONE	TOXAPHENE	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	AROCLOR 1260
676WES- 36	140/15OAP03	2	1/5/94	0.248	0.248 U	0.060 U	0.248 U	50.6	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 37	140/150PD01	2	1/5/94	4.77	0.246 U	0.060 U	0.246 U	26.2 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 38	140/15OPD02	2	1/5/94	6.32	0.245 U	0.060 U	0.245 U	77.0	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 39	140/150PD03	2	1/5/94	7.33	0.242 U	0.059 U	0.242 U	88.0	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 40	140/150QP01	2	1/5/94	3.68	0.250 U	0.061 U	0.250 U	35.9 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 41	140/150QP02	2	1/5/94	5.50	0.249 U	0.061 U	0.249 U	34.8 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 42	140/150QP03	2	1/5/94	0.278 U	0.278 U	0.068 U	0.278 U	72.7	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 43	760PP01	2	1/5/94	1.65	0.193 U	0.046 U	1.38 B	30.9 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 44	760PP02	2	1/5/94	1.32	2.24	0.047 U	0.196 U	27.5 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 45	760PP03	2	1/5/94	1.44	0.242 U	0.058 U	1.02 B	29.2 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 46	760QP01	2	1/5/94	2.31	0.241 U	0.057 U	0.241 U	94.7	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 47	760QP02	2	1/5/94	2.54	0.246 U	0.059 U	0.246 U	92.0	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 48	760QP03	2	1/5/94	1.21	0.243 U	0.059 U	0.243 U	56.7	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 49	633MN01	2	1/5/94	0.222 U	0.222 U	0.054 U	0.222 U	165	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 50	633MN02	2	1/5/94	0.238 U	0.238 U	0.058 U	0.238 U	150	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 51	633MN03	2	1/5/94	0.247 U	0.247 U	0.059 U	0.247 U	177	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 52	760AP01	2	1/5/94	1.55	0.241 U	0.058 U	0.241 U	32.3 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 53	760AP02	2	1/5/94	1.72	0.241 U	0.058 U	0.837 B	31.5 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 54	760QP03	2	1/5/94	2.03	0.226 U	0.055 U	0.226 U	81.5	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 55	792QP01	2	1/5/94	1.79	0.239 U	0.058 U	0.239 U	31.4 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 56	792QP02	2	1/5/94	2.05	0.246 U	0.059 U	0.246 U	90.3	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 57	792QP03	2	1/5/94	1.55	0.244 U	0.058 U	1.22 B	60.8	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 58	792AP01	2	1/5/94	2.23	0.245 U	0.059 U	0.855 B	76.2	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 59	792AP03	2	1/5/94	2.26	0.242 U	0.058 U	0.242 U	36.4 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 60	792AP04	2	1/5/94	1.55	0.236 U	0.056 U	0.639 B	32.2 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 61	792PD01	2	1/5/94	2.00	1.53	0.055 U	1.22 B	33.3 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 62	792PD02	2	1/5/94	1.45	0.225 U	0.054 U	0.225 U	84.2	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 63	792PD03	2	1/5/94	2.35	0.241 U	0.059 U	0.241 U	111	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 64	633LT02	2	1/5/94	0.242 U	0.242 U	0.058 U	0.242 U	27.7 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 65	633LT03	2	1/5/94	1.05	0.218 U	0.053 U	0.218 U	21.9 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 66	633LT04	2	1/5/94	1.45	0.241 U	0.058 U	0.606 B	42.6	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 67	664QP01	2	1/5/94	1.21	0.321 U	0.078 U	0.321 U	32.0 U	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 68	664QP02	2	1/5/94	0.245 U	0.245 U	0.060 U	0.245 U	71.1	28.0 U	28.0 U	28.0 U	28.0 U
676WES- 69	664QP04	2	1/5/94	0.735	0.217 U	0.052 U	1.35 B	30.0 U	28.0 U	28.0 U	28.0 U	28.0 U
Blank-1		2	1/5/94	0.250 U	0.250 U	0.060 U	0.526	30.0 U	28.0 U	28.0 U	28.0 U	28.0 U
Blank-2		2	1/5/94	0.250 U	0.250 U	0.060 U	0.250 U	30.0 U	28.0 U	28.0 U	28.0 U	28.0 U

3/25/94

USACE - WES/TATEM
PESTICIDES IN MUSSEL TISSUE SAMPLES
BATCH 2

(concentrations in µg/g wet wt.)

MSL Code	Sponsor ID	Batch	Extract Date	ENDO-SULFAN SULFATE	METH-OXYCLOR	MIREX	ENDRIN KETONE	TOXAPHENE	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	AROCLOR 1260
BLANK SPIKE RESULTS												
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	50.0	NS
Blank-1		2	1/5/94	NS	NS	NS	NS	NS	NS	NS	28.0 U	NS
Blank-1 + Spike 1		2	1/5/94	NS	NS	NS	NS	NS	NS	NS	48.2	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	48.2	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	96%	NS
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	50.0	NS
Blank-1		2	1/5/94	NS	NS	NS	NS	NS	NS	NS	28.0 U	NS
Blank-1 + Spike 2		2	1/5/94	NS	NS	NS	NS	NS	NS	NS	54.8	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	54.8	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	110%	NS
MATRIX SPIKE RESULTS												
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	50.2	NS
676WES- 1	792PD03	2	1/5/94	NS	NS	NS	NS	NS	NS	NS	28.0 U	NS
676WES-63 + Spike 1		2	1/5/94	NS	NS	NS	NS	NS	NS	NS	56.1	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	56.1	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	112%	NS
Amount Spiked				NS	NS	NS	NS	NS	NS	NS	50.2	NS
676WES- 1	792PD03	2	1/5/94	NS	NS	NS	NS	NS	NS	NS	28.0 U	NS
676WES-63 + Spike 2		2	1/5/94	NS	NS	NS	NS	NS	NS	NS	56.1	NS
Amount Recovered				NS	NS	NS	NS	NS	NS	NS	56.1	NS
Percent Recovery				NS	NS	NS	NS	NS	NS	NS	112%	NS

U = Not detected at or above the detection limit shown
D = Sample results taken from diluted extract (1:10)
NA = Not applicable
NC = Not certified
NS = Not spiked
* = PCB 103 co-eluted with g-BHC. This surrogate was not used in quantitation.
# = Outside QC criteria (50-150%)
B = Values detected in samples were <5 x the levels found in associated blank.

Appendix C
Statistical Analyses of Some of Big Sunflower Mussel Contaminants Data

CADMIUM (ppm wet wt.) IN MUSSELS FROM THE SUNFLOWER RIVER

OBS	TREATMENT GROUP	N	MEAN CONTAMINANT CONC.	VARIANCE	STANDARD ERROR
1	34.5	9	0.14222	.0082062	0.030196
2	62.2	9	0.08290	.0028480	0.017789
3	63.3	12	0.09031	.0015732	0.011450
4	66.4	9	0.07904	.0012740	0.011898
5	76.0	9	0.08542	.0005001	0.007455
6	79.2	9	0.09076	.0020649	0.015147
7	140.0	9	0.07799	.0006882	0.008744

COMPARISON OF MEAN BIOACCUMULATION WITH ACTION LEVEL:
UPPER CONFIDENCE LIMITS (UCL) WHEN VARIANCES ARE UNEQUAL
CADMIUM

TREATMENT GROUP	MEAN BIOACCUMULATION	* UCL (UNEQUAL VARIANCES)	VARIANCE	T VALUE FOR (1-ALPHA=.95,N-1)	N	MINIMUM SIGNIFICANT DIFFERENCE
34.5	0.14222	0.19837	.0082062	1.85955	9	0.056151
62.2	0.08290	0.11598	.0028480	1.85955	9	0.033079
63.3	0.09031	0.11087	.0015732	1.79588	12	0.020563
66.4	0.07904	0.10116	.0012740	1.85955	9	0.022125
76.0	0.08542	0.09928	.0005001	1.85955	9	0.013862
79.2	0.09076	0.11892	.0020649	1.85955	9	0.028167
140.0	0.07799	0.09425	.0006882	1.85955	9	0.016261

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 0.5 ppm GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	0.45	0.05	1.3869	0.91466
20	0.40	0.10	4.4449	0.99998
30	0.35	0.15	7.5029	1.00000
40	0.30	0.20	10.5610	1.00000
50	0.25	0.25	13.6190	1.00000

*** 95 Percent upper confidence limit values used in Table 8.**

MERCURY (ppm wet wt.) IN MUSSELS FROM THE SUNFLOWER RIVER

OBS	TREATMENT GROUP	N	MEAN CONTAMINANT CONC.	VARIANCE	STANDARD ERROR
1	34.5	9	0.018773	.00003884	.0020773
2	62.2	9	0.014276	.00002875	.0017872
3	63.3	12	0.020160	.00013487	.0033525
4	66.4	9	0.014489	.00000801	.0009436
5	76.0	9	0.014916	.00001490	.0012869
6	79.2	9	0.015822	.00000606	.0008208
7	140.0	9	0.012587	.00000175	.0004406

COMPARISON OF MEAN BIOACCUMULATION WITH ACTION LEVEL:
UPPER CONFIDENCE LIMITS (UCL) WHEN VARIANCES ARE UNEQUAL
MERCURY

TREATMENT GROUP	MEAN BIOACCUMULATION	* UCL (UNEQUAL VARIANCES)	VARIANCE	T VALUE FOR (1-ALPHA=.95,N-1)	N	MINIMUM SIGNIFICANT DIFFERENCE
34.5	0.018773	0.022636	.00003884	1.85955	9	.0038628
62.2	0.014276	0.017599	.00002875	1.85955	9	.0033234
63.3	0.020160	0.026181	.00013487	1.79588	12	.0060207
66.4	0.014489	0.016244	.00000801	1.85955	9	.0017547
76.0	0.014916	0.017309	.00001490	1.85955	9	.0023930
79.2	0.015822	0.017349	.00000606	1.85955	9	.0015263
140.0	0.012587	0.013406	.00000175	1.85955	9	.0008193

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 0.1 ppm GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	0.09	0.01	3.1654	0.99877
20	0.08	0.02	8.0018	1.00000
30	0.07	0.03	12.8383	1.00000
40	0.06	0.04	17.6748	1.00000
50	0.05	0.05	22.5113	1.00000

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 1.0 ppm GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	0.9	0.1	46.694	1
20	0.8	0.2	95.058	1
30	0.7	0.3	143.423	1
40	0.6	0.4	191.788	1
50	0.5	0.5	240.152	1

LEAD (ppm wet wt.) IN MUSSELS FROM THE SUNFLOWER RIVER

OBS	TREATMENT GROUP	N	MEAN CONTAMINANT CONC.	VARIANCE	STANDARD ERROR
1	34.5	9	0.08322	.0005548	0.007851
2	62.2	9	0.04668	.0000418	0.002154
3	63.3	12	0.10052	.0019749	0.012829
4	66.4	9	0.06784	.0006019	0.008178
5	76.0	9	0.06862	.0003676	0.006391
6	79.2	9	0.07227	.0001922	0.004621
7	140.0	9	0.04377	.0001079	0.003462

COMPARISON OF MEAN BIOACCUMULATION WITH ACTION LEVEL:
UPPER CONFIDENCE LIMITS (UCL) WHEN VARIANCES ARE UNEQUAL
LEAD

TREATMENT GROUP	MEAN BIOACCUMULATION	* UCL (UNEQUAL VARIANCES)	VARIANCE	T VALUE FOR (1-ALPHA=.95,N-1)	N	MINIMUM SIGNIFICANT DIFFERENCE
34.5	0.08322	0.09782	.0005548	1.85955	9	0.014600
62.2	0.04668	0.05069	.0000418	1.85955	9	0.004005
63.3	0.10052	0.12356	.0019749	1.79588	12	0.023039
66.4	0.06784	0.08305	.0006019	1.85955	9	0.015207
76.0	0.06862	0.08051	.0003676	1.85955	9	0.011885
79.2	0.07227	0.08086	.0001922	1.85955	9	0.008594
140.0	0.04377	0.05021	.0001079	1.85955	9	0.006438

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 0.3 ppm GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	0.27	0.03	1.9398	0.97140
20	0.24	0.06	5.5507	1.00000
30	0.21	0.09	9.1615	1.00000
40	0.18	0.12	12.7724	1.00000
50	0.15	0.15	16.3833	1.00000

SELENIUM (ppm wet wt.) IN MUSSELS FROM THE SUNFLOWER RIVER

OBS	TREATMENT GROUP	N	MEAN CONTAMINANT CONC.	VARIANCE	STANDARD ERROR
1	34.5	9	0.46844	0.010196	0.033659
2	62.2	9	0.44604	0.001092	0.011014
3	63.3	12	0.44333	0.004398	0.019144
4	66.4	9	0.37547	0.001484	0.012839
5	76.0	9	0.39022	0.004985	0.023534
6	79.2	9	0.36569	0.002539	0.016796
7	140.0	9	0.36818	0.000409	0.006743

COMPARISON OF MEAN BIOACCUMULATION WITH ACTION LEVEL:
UPPER CONFIDENCE LIMITS (UCL) WHEN VARIANCES ARE UNEQUAL
SELENIUM

TREATMENT GROUP	MEAN BIOACCUMULATION	* UCL (UNEQUAL VARIANCES)	VARIANCE	T VALUE FOR (1-ALPHA=.95,N-1)	N	MINIMUM SIGNIFICANT DIFFERENCE
34.5	0.46844	0.53103	0.010196	1.85955	9	0.062590
62.2	0.44604	0.46652	0.001092	1.85955	9	0.020480
63.3	0.44333	0.47771	0.004398	1.79588	12	0.034380
66.4	0.37547	0.39934	0.001484	1.85955	9	0.023874
76.0	0.39022	0.43398	0.004985	1.85955	9	0.043762
79.2	0.36569	0.39692	0.002539	1.85955	9	0.031233
140.0	0.36818	0.38072	0.000409	1.85955	9	0.012539

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 0.5 ppm GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	0.45	0.05	0.8195	0.79209
20	0.40	0.10	3.3101	0.99920
30	0.35	0.15	5.8006	1.00000
40	0.30	0.20	8.2912	1.00000
50	0.25	0.25	10.7818	1.00000

CHROMIUM (ppm wet wt.) IN MUSSELS FROM THE SUNFLOWER RIVER

OBS	TREATMENT GROUP	N	MEAN CONTAMINANT CONC.	VARIANCE	STANDARD ERROR
1	34.5	9	0.23788	0.004092	0.021323
2	62.2	9	0.23556	0.003459	0.019605
3	63.3	12	0.19951	0.002793	0.015255
4	66.4	9	0.26057	0.009401	0.032320
5	76.0	9	0.25442	0.014615	0.040298
6	79.2	9	0.45173	0.025070	0.052778
7	140.0	9	0.13872	0.000000	0.000000

COMPARISON OF MEAN BIOACCUMULATION WITH ACTION LEVEL:
UPPER CONFIDENCE LIMITS (UCL) WHEN VARIANCES ARE UNEQUAL
CHROMIUM

TREATMENT GROUP	MEAN BIOACCUMULATION	* UCL (UNEQUAL VARIANCES)	VARIANCE	T VALUE FOR (1-ALPHA=.95,N-1)	N	MINIMUM SIGNIFICANT DIFFERENCE
34.5	0.23788	0.27754	0.004092	1.85955	9	0.039651
62.2	0.23556	0.27201	0.003459	1.85955	9	0.036456
63.3	0.19951	0.22690	0.002793	1.79588	12	0.027397
66.4	0.26057	0.32067	0.009401	1.85955	9	0.060100
76.0	0.25442	0.32935	0.014615	1.85955	9	0.074936
79.2	0.45173	0.54988	0.025070	1.85955	9	0.098144
140.0	0.13872	0.13872	0.000000	1.85955	9	0.000000

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 0.2 ppm GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	0.18	0.02	-1.00852	0.15866
20	0.16	0.04	-0.34594	0.36531
30	0.14	0.06	0.31664	0.62368
40	0.12	0.08	0.97921	0.83426
50	0.10	0.10	1.64179	0.94702

DIELDRIN (ppb wet wt.) IN MUSSELS FROM THE SUNFLOWER RIVER

OBS	TREATMENT GROUP	N	MEAN CONTAMINANT CONC.	VARIANCE	STANDARD ERROR
1	34.5	9	2.08444	0.2697	0.17311
2	62.2	9	2.83889	0.5841	0.25476
3	63.3	15	1.97267	1.5313	0.31951
4	66.4	9	2.80111	11.7741	1.14378
5	76.0	9	0.14444	0.0002	0.00503
6	79.2	9	0.15222	0.0000	0.00222
7	140.0	9	3.32333	0.6198	0.26242

COMPARISON OF MEAN BIOACCUMULATION WITH ACTION LEVEL:
UPPER CONFIDENCE LIMITS (UCL) WHEN VARIANCES ARE UNEQUAL
DIELDRIN

TREATMENT GROUP	MEAN BIOACCUMULATION	* UCL (UNEQUAL VARIANCES)	VARIANCE	T VALUE FOR (1-ALPHA=.95,N-1)	N	MINIMUM SIGNIFICANT DIFFERENCE
34.5	2.08444	2.40635	0.2697	1.85955	9	0.32191
62.2	2.83889	3.31262	0.5841	1.85955	9	0.47373
63.3	1.97267	2.53542	1.5313	1.76131	15	0.56275
66.4	2.80111	4.92802	11.7741	1.85955	9	2.12691
76.0	0.14444	0.15380	0.0002	1.85955	9	0.00935
79.2	0.15222	0.15635	0.0000	1.85955	9	0.00413
140.0	3.32333	3.81132	0.6198	1.85955	9	0.48799

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 100 ppb GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	90	10	19.257	1
20	80	20	40.183	1
30	70	30	61.110	1
40	60	40	82.036	1
50	50	50	102.963	1

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 300 ppb GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	270	30	61.110	1
20	240	60	123.889	1
30	210	90	186.668	1
40	180	120	249.448	1
50	150	150	312.227	1

DDTM (ppb wet wt.) IN MUSSELS FROM THE SUNFLOWER RIVER

OBS	TREATMENT GROUP	N	MEAN CONTAMINANT CONC.	VARIANCE	STANDARD ERROR
1	34.5	9	138.027	1325.62	12.1364
2	62.2	9	181.507	2128.36	15.3781
3	63.3	15	145.716	1217.78	9.0103
4	66.4	9	148.746	4368.73	22.0321
5	76.0	9	114.663	623.39	8.3226
6	79.2	9	134.507	833.06	9.6209
7	140.0	9	71.193	304.19	5.8136

COMPARISON OF MEAN BIOACCUMULATION WITH ACTION LEVEL:
UPPER CONFIDENCE LIMITS (UCL) WHEN VARIANCES ARE UNEQUAL
DDTM

TREATMENT GROUP	MEAN BIOACCUMULATION	* UCL (UNEQUAL VARIANCES)	VARIANCE	T VALUE FOR (1-ALPHA=.95,N-1)	N	MINIMUM SIGNIFICANT DIFFERENCE
34.5	138.027	160.595	1325.62	1.85955	9	22.5681
62.2	181.507	210.103	2128.36	1.85955	9	28.5963
63.3	145.716	161.586	1217.78	1.76131	15	15.8699
66.4	148.746	189.715	4368.73	1.85955	9	40.9698
76.0	114.663	130.140	623.39	1.85955	9	15.4763
79.2	134.507	152.397	833.06	1.85955	9	17.8906
140.0	71.193	82.004	304.19	1.85955	9	10.8107

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 1000 ppb GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	900	100	6.0465	1.00000
20	800	200	13.7629	1.00000
30	700	300	21.4792	1.00000
40	600	400	29.1955	1.00000
50	500	500	36.9119	1.00000

POWER TO DETECT % DECREASE IN CONCENTRATION BELOW
ACTION LEVEL OF 5000 ppb GIVEN N, MSE AND DF FROM ANOVA

% DECREASE BELOW ACTION LEVEL	MEAN BIOACCUMULATION	D	T VALUE FOR (1-BETA,DF)	POWER (1-BETA)
10	4500	500	36.912	1
20	4000	1000	75.494	1
30	3500	1500	114.075	1
40	3000	2000	152.657	1
50	2500	2500	191.238	1

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13. ABSTRACT *(Maximum 200 words)*

Nine species of freshwater mussels collected from the Big Sunflower River, Mississippi, in 1993 were chemically analyzed for three classes of environmental contaminants. There was a proposal to harvest these animals for their shells and to use the tissues for animal feed. Mussels were collected from eight sites, from River Miles 34.5 to 150 (near Cleveland, MS). The tissues were analyzed for metals, pesticides, and polychlorinated biphenyls (PCBs). Metals, including Cd, Hg, Pb, Se, Ni, and Cr, were found at concentrations generally <3.0 ppm dry wt. Hg concentrations were generally <0.2 ppm dry wt. The animals did not contain PCBs, analyzed as Aroclors, at the 5-ppb detection limit. Many pesticides such as toxaphene, DDT compounds, chlordane, and dieldrin were found in these mussels. Most of the concentrations were in the <0.1-ppm wet wt. range; however, the data show that some of these mussels contained toxaphene at concentrations in the 0.2- to 0.4-ppm wet wt. range. The contaminants were not specific to any single site or mussel species but were fairly evenly distributed. Statistical analyses of the contaminants data were used to determine whether the metals or pesticides exceeded the U.S. Food and Drug Administration action limits or the U.S. Fish and Wildlife Service predator protection limits. Based on these analyses and the levels of toxaphene found in some of the species, recommendations were made that the tissues not be used as animal feed.

14. SUBJECT TERMS

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